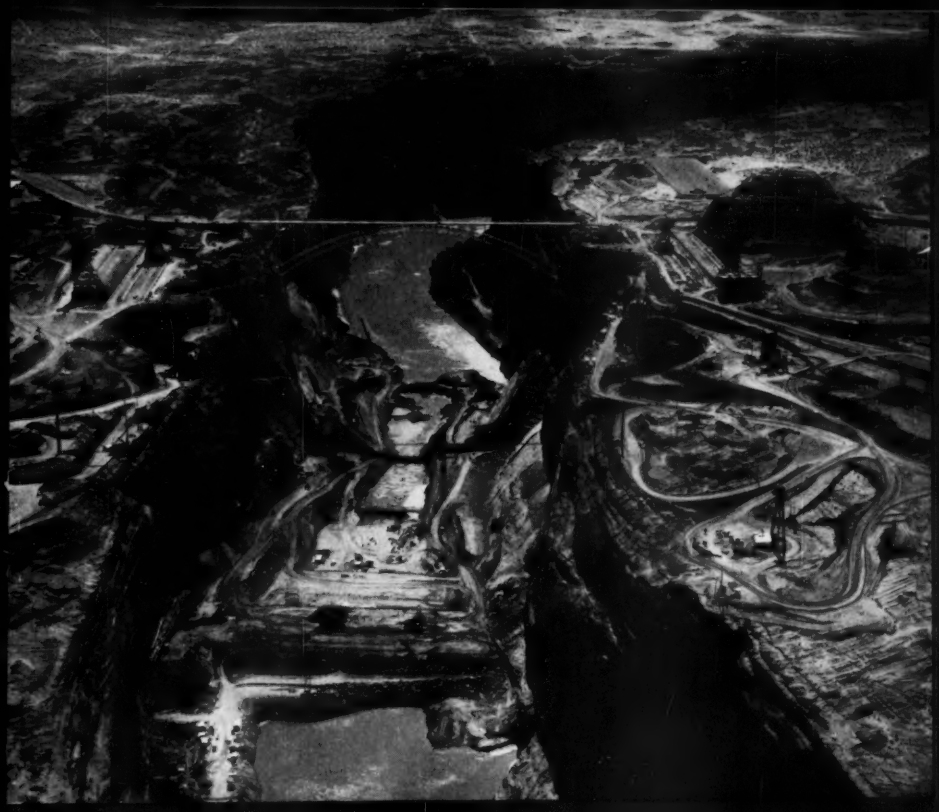

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CIVIL ENGINEERING

JUNE 1959
VOL. 29 • NO. 6

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• *ARTICLES*

• *SOCIETY NEWS*

• *NEWS BRIEFS*

• *DEPARTMENTS*

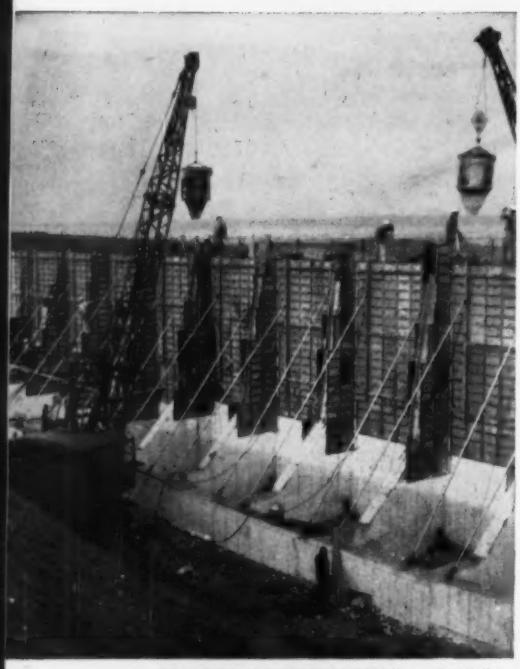
CONCRETE PERFORMANCE REPORT

POZZOLITH concrete employed in new Air Force Academy to meet full range of engineering requirements for all types of concrete specified

Largest single construction project in U. S. Air Force history, the Air Force Academy Complex at Colorado Springs marks a milestone in modern concrete design and construction. Nearly 95% of the $114 million allocated for "pure construction" has gone into nearly 70 major building contracts—including over 4 million square feet of enclosed floor area. Construction at the 17,900 acre Academy site included the placing of some 800,000 cubic yards of concrete for buildings, retaining walls and bridges.

On-site concrete control lab—The Air Force Academy Construction Agency and the architects—Skidmore, Owings, and Merrill—jointly supervised all construction and established an on-site concrete materials control laboratory early in 1956. During July and August, 1956—with only a few thousand yards of concrete placed—they observed erratic and low compressive concrete strengths. The wide range and rapid changes in temperature were suspected as the cause.

AIR FORCE



CONCRETE RETAINING WALLS reach 36 feet high over much of the 10,000 foot wall length. Tallest pours were made by giant overhead crane. Walls required approximately 24,000 cubic yards of POZZOLITH concrete—a placeable mix of 2" to 4" slump with design strength of 3,000 psi. Contractor: T. F. Scholes, Inc., Reading, Pennsylvania. Concrete Contractor: Long Construction Co., Denver.

Evaluation tests of concrete materials—In August, they engaged Commercial Testing Laboratories, Denver, to make comprehensive tests. Their tests clearly established that POZZOLITH would provide uniform, high strength throughout the wide range of temperature changes experienced between early morning concreting at about 50°F and mid-day concreting at 75° to 80°F. In September 1956, POZZOLITH was first employed in concrete at the Academy. Its successful performance here led the engineers to investigate the use of POZZOLITH for control of other classes of concrete—including lightweight aggregate concrete, prestressed concrete and structural concrete. *As a result of this investigation,* POZZOLITH *and only* POZZOLITH *was used as the water-reducing, set-controlling admixture for the project.*

2-mile retaining wall—Concurrent with concreting of foundation caissons, work began on 10,000 feet of concrete retaining wall that reached a height of 36 feet over much of its length.

Design strength of the concrete required here was 3,000 psi at 28 days. With 1½" top size aggregate, 5 bags of cement, 36 gallons of water and POZZOLITH—a placeable mix of 2" to 4" slump was obtained that readily exceeded the 3,000 psi specification. Tremie trunks were used to limit the free fall of the concrete to 5 feet—maximum permitted by specifications. The mix was easily vibrated into place with no segregation or honeycomb. Retaining walls required approximately 24,000 cubic yards of concrete—supplied by a job site batch plant and delivered in ready-mix trucks. This mix met strength specifications and provided necessary workability for proper placement in the heavily reinforced, narrow forms.

Prestressed bridge girders—Construction work also included the erection of six prestressed bridges varying in length from 144 to 600 feet. There were two railway spans and four highway bridges—their girders standardized at 120 feet long in a modified T design, 71" deep. In all, 128 girders were manufactured. Sixteen shorter girders were erected for the two railroad bridges each of which consists of two simple supported spans of 72 feet each.

Concrete for these girders contained 7½ sacks of Type I cement, 1760 lbs. coarse aggregate (¾" top size), 1300 lbs. sand, 30.5 gallons of water and POZZOLITH Retarder.

This produced a cohesive, workable mix of about 2" slump and 4% entrained air. The POZZOLITH Retarder provided an initial retardation which permitted proper consolidation of the mix, yet accelerated early strength. Specifications called for a compressive strength of 4,500 psi before application of stress. This strength was achieved in three to five days, air cured. Stress was applied at that time. Concrete attained a compressive strength of approximately 6,500 psi in 7 days and well over 7,000 psi in 28 days.

Concreting bridge decks—Initial retardation was required in the concrete bridge decks to provide an initial delay in hardening so that the complete deck for each span could be completely

AERIAL VIEW of nearly completed Air Force Academy. Construction under supervision of the Air Force Academy Construction Agency. Architects: Skidmore, Owings & Merrill, Chicago • Contractors include: Jack Adams & Haake Construction Co., Santa Fe, New Mexico • B. H. Baker Co., Inc., Colorado Springs • J. W. Bateson Co., Inc., Dallas • T. C. Bateson Construction Co., Dallas • A. H. Beck Foundation Co., San Antonio • Colorado Constructors, Inc., Denver • Dondlinger & Sons Construction Co., Inc., Wichita • E. & M. Construction Co., Denver • Elgas Construction Co., Colorado Springs • Farnsworth & Chambers Co., Inc., Houston • A. S. Horner Construction Co., Denver • Peter Kiewit & Sons' Co., Denver • Wade Lahar Construction Co., Tulsa & Denver • Long Construction Co., Denver • Matelich & Hanson, Inc., Englewood, Colorado • Robert E. McKee, Inc., Santa Fe, New Mexico • Mountain States Construction Co., Denver • Nowers Construction Co., Pueblo, Colorado • Frederick Raff Co., Colorado Springs • Ramsey-Leftwich, Lubbock • Saxet Foundation Co., San Antonio • T. F. Scholes, Inc., Reading, Pa. • Del E. Webb & Rubenstein Construction Companies, Phoenix • J. F. White Engineering Co., Englewood, Colorado • POZZOLITH Ready-Mixed Concrete: Concrete Materials, Inc., Kansas City • General Concrete Co., Colorado Springs • Transit Mix Concrete Co., Colorado Springs.

economically, for the broad range of job requirements and varied climatic conditions encountered at the site.

The Master Builders field men and the Company engineering staff worked closely with project engineers, the field control laboratory, contractors, and concrete suppliers to achieve the common goal of uniform, superior quality concrete at lowest cost-in-place.

For *your* job . . . with *your* materials POZZOLITH concrete is best. Neither plain concrete nor concrete with any other admixture can match the results you obtain with today's POZZOLITH.

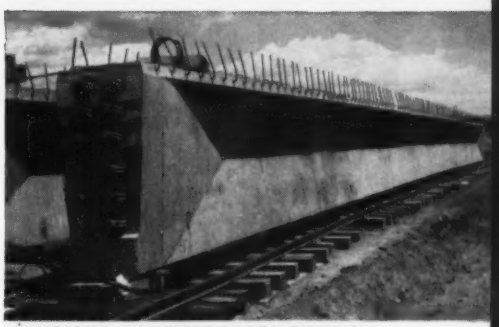
On any current or future concrete projects, the local Master Builders field man will welcome discussing your requirements. Call him in. He's at your service—and expertly assisted by the Master Builders research and engineering staff—unexcelled in the field of concrete technology. Write us for complete information.

ACADEMY

poured before initial set occurred. This permitted full dead load deflection and achieved true composite action between girders and the concrete deck. Because the contractor wanted to use the completed decks as work areas in placing girders for the remaining spans, it was important that these slabs be placed into service at an early date. POZZOLITH Retarder provided the required, controlled initial delay in hardening and produced early strengths equal or better to what could be expected with a comparable plain concrete mix. At placing temperatures below 50°F, no extended delay in hardening occurred.

Lightweight concrete—Design of many of the buildings included lightweight aggregate concrete floors for the second, third and fourth stories—and concrete roofs. Preliminary mix designs indicated that with local lightweight coarse aggregates, natural sand for most of the fine aggregate and POZZOLITH—the 3,000 psi compressive strength specification could be met with 5 sacks of cement and air content maintained at 9% ± 1½%. This lightweight concrete had excellent workability and weighed approximately 105 lbs. per cubic foot, well below the 110 lb. maximum specified.

POZZOLITH and Master Builders field service—POZZOLITH was an important aid in meeting and exceeding specification requirements in over 750,000 of the 800,000 cubic yards of concrete at the Air Force Academy. For each of the many classes and types of concrete specified—it provided the required batch-to-batch uniformity, most



PRESTRESSED CONCRETE BRIDGE GIRDERS attained 28-day compressive strength of over 7,000 psi. Construction of all 144 POZZOLITH girders was by A. S. Horner Construction Co., Contractors, Denver. Consulting Engineer: L. Boduroff, Denver. Prestressing: Prescon Corp., Corpus Christi, Texas.

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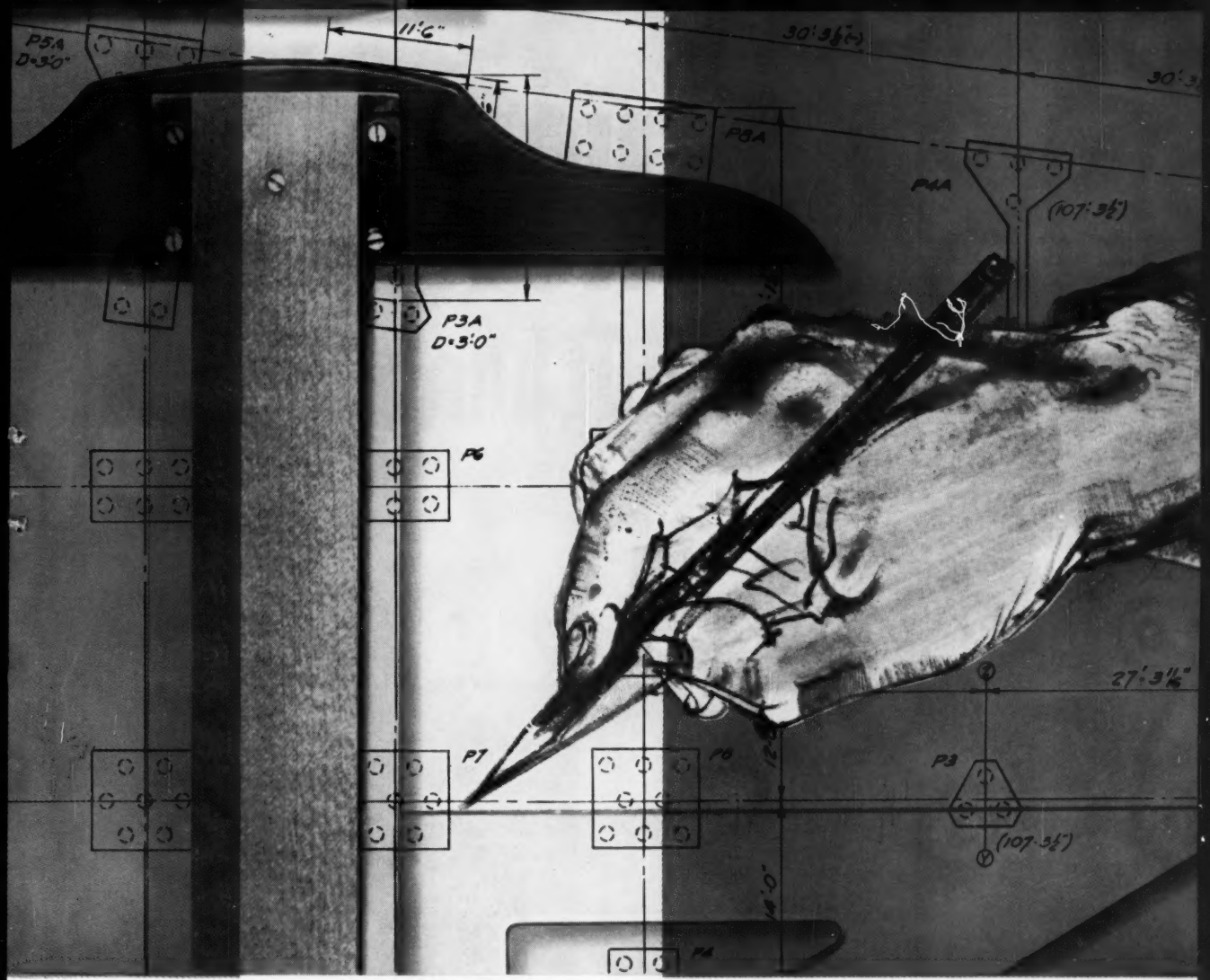

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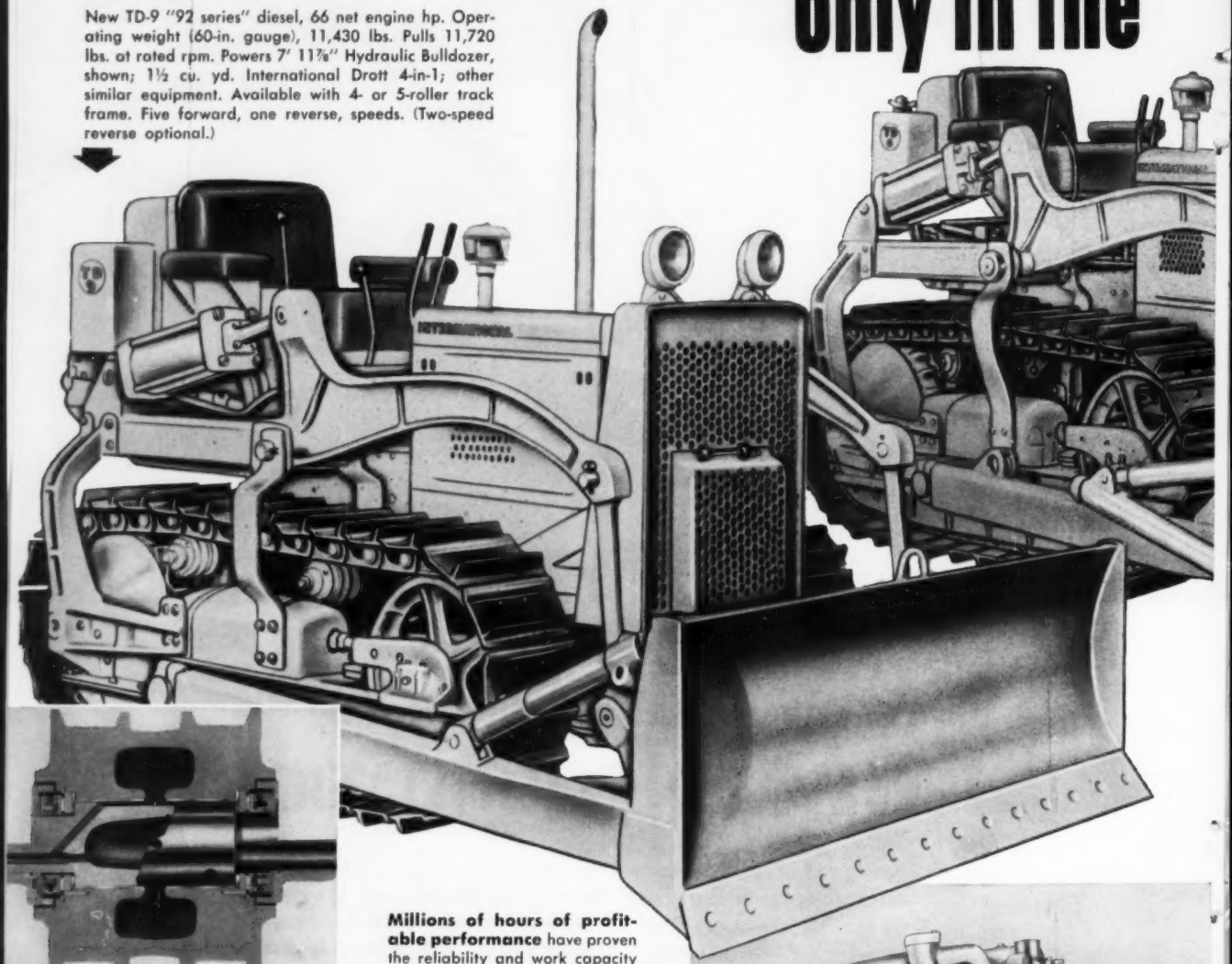
only in the

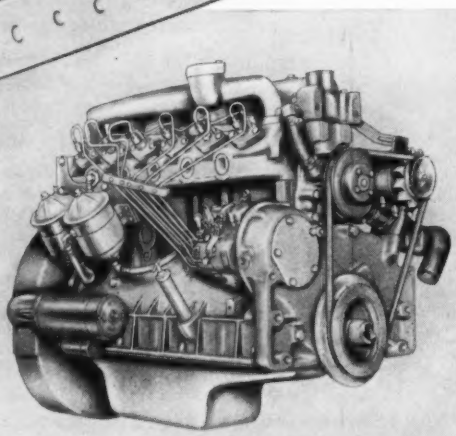
New TD-6 "62 series" diesel, 52 net engine hp. Operating weight (50-in. gauge), 8,665 lbs. Pulls 8,715 lbs. at rated rpm. Powers 8' 10½" Hydraulic Bullgrader shown; 1⅛ cu. yd. International Drott 4-in-1; other similar equipment. Available with 4- or 5-roller track frames. Five forward, one reverse, speeds. (Two-speed reverse, optional.)

New TD-9 "92 series" diesel, 66 net engine hp. Operating weight (60-in. gauge), 11,430 lbs. Pulls 11,720 lbs. at rated rpm. Powers 7' 11⅞" Hydraulic Bulldozer, shown; 1½ cu. yd. International Drott 4-in-1; other similar equipment. Available with 4- or 5-roller track frame. Five forward, one reverse, speeds. (Two-speed reverse optional.)



New 500-hr. lube interval TD-6 and TD-9 track rollers are of heavy-duty International design. Heavy-duty roller bushings are supplied from big 300% increased lube reservoirs. Exclusive vented shafts in top and front idlers, and in track rollers protect the seals from over-lubrication.

Millions of hours of profitable performance have proven the reliability and work capacity of the D-282 6-cylinder diesel engine. It's naturally-aspirated in the TD-6; turbocharged in the TD-9. Direct-electric started, this fast-governed performer features the most simple, efficient, and compact rotary-type fuel-injection pump built! Other D-282 long-life, low-upkeep features include: tri-metal main and connecting rod bearings; file-hard, replaceable cylinder sleeves; and extra power from every ounce of fuel energy put to work with a new super-swirl piston face.



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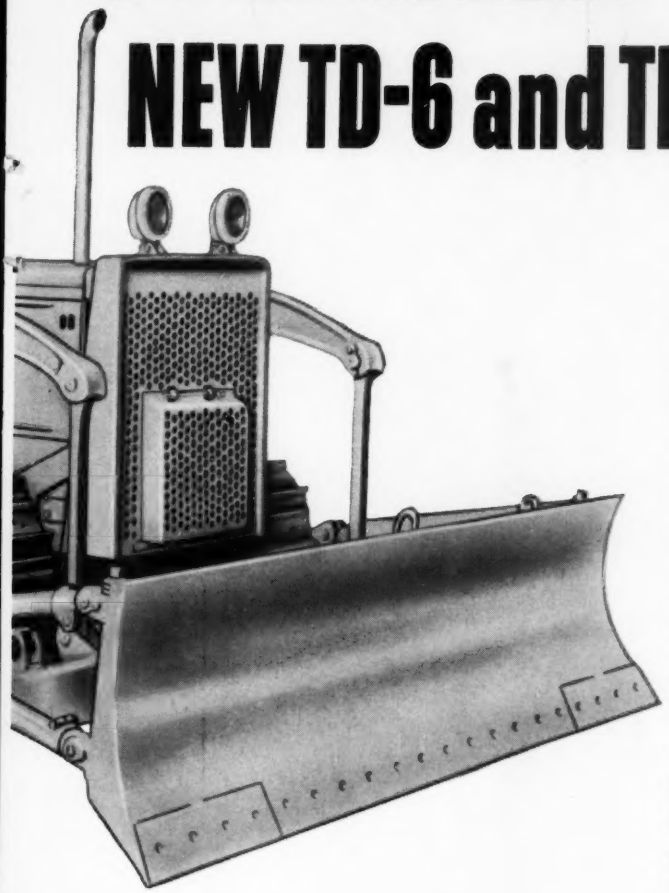
NEW TD-6 and TD-9!



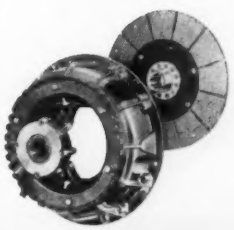
Now you get the smoothness, the high-production power wallop, the dependability of a fully-proven, fuel-thrifty 6-cylinder International diesel engine—only in the new TD-6 and TD-9 crawlers. This high-torque diesel has direct-electric starting; simple, compact, rotary-type precision fuel injection!

New TD-6 and TD-9 crawlers have exclusive vented shafts in track rollers, and top and front idlers, to assure positive seal protection from over-lubrication. And newly-designed track roller shells have a big, 300% increased lube capacity, to make 500-hour lube intervals a practical reality!

Both of these versatile new models have the power-transfer efficiency, and all-temperature workability of new dry-type, full-face sintered metal engine clutches. Choose from a proven line of dozers, loaders, and other equipment to take full advantage of TD-6 or TD-9 six-cylinder power!

From direct-start button to heavy-duty radiator guard, new TD-6 and TD-9 crawlers practically put their new production boosting advantages under "touch control." Let a "no-holds barred" competitive demonstration prove how easily you get their big bonus margin of earning capacity. See your International Construction Equipment Distributor!

Smooth, high-torque 6-cylinder diesel power make the new TD-6 or TD-9 ideal clean-up dozer units on any sized contract; or main-producing units with dozer or excavator-loader on many sizes of jobs!



Here's the sintered metal engine clutch driven member—for TD-6 and TD-9 crawlers. New full-face design provides smooth mating of surfaces, gives the holding power and heat defiance for full-torque performance. And you get all the other advantages of dry-type clutch simplicity and low upkeep!

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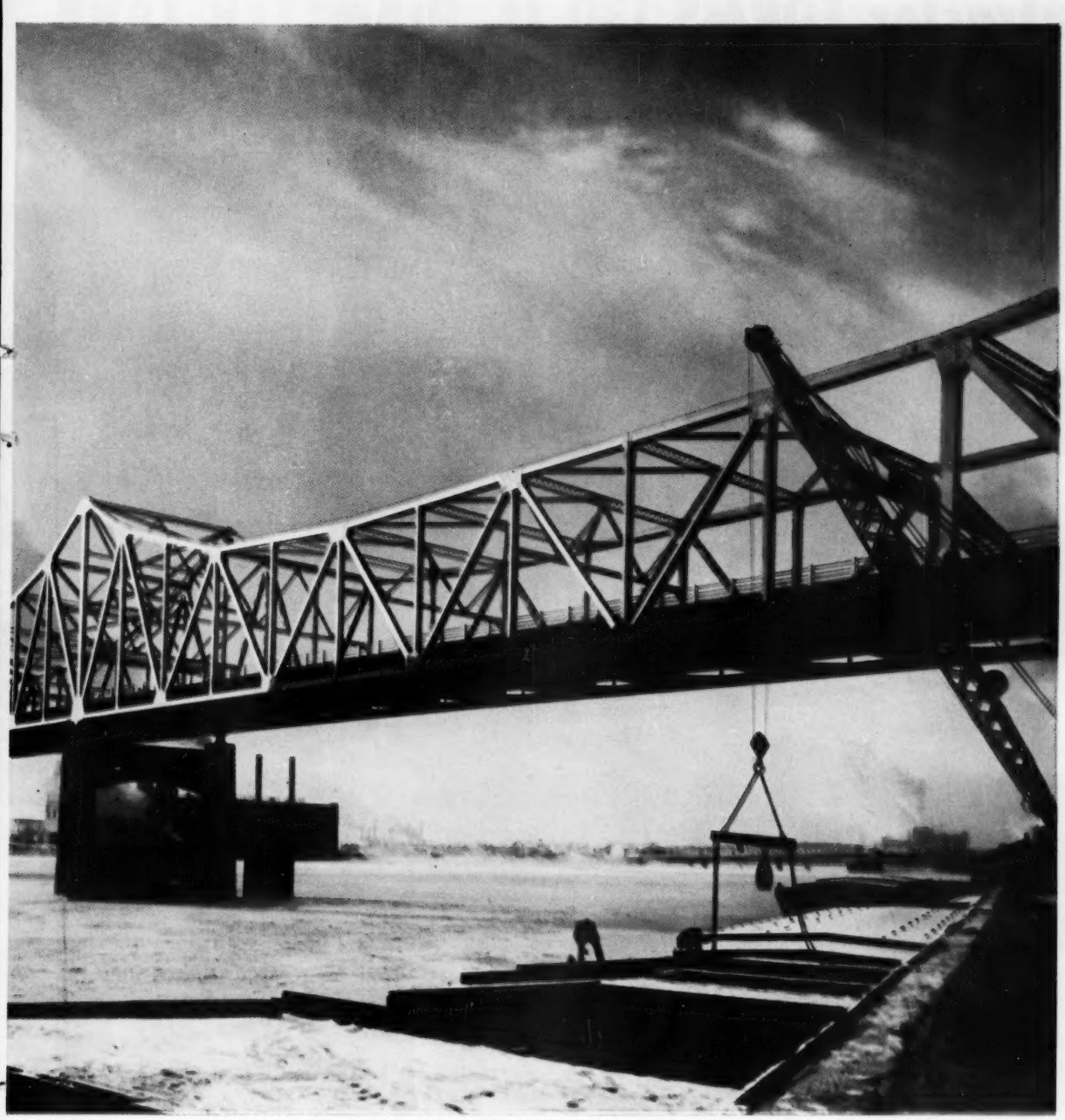
A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom-Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.



mately, fewer maintenance problems. It is estimated that $175,000 was saved by using TRI-TEN Steel.

USS TRI-TEN Steel is particularly recommended for welded structures. It has good workability and superior resistance to atmospheric corrosion and meets all the requirements of ASTM Specification A242.

Other USS High Strength Steels in the 50,000 psi minimum yield point range include USS MAN-TEN which combines strength with economy and USS COR-TEN for strength with outstanding resistance to atmospheric corrosion. Where a very high yield strength steel is needed, our USS "T-1" Constructional Alloy Steel combines weldability with 100,000 psi minimum yield strength.

For complete information on any of these steels, call our nearest sales office or write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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When a contractor can erect, align, and brace the forms for a 130 ft. diameter, 13 ft. high tank in *a single 9 hour day* — that's speed! And when *total costs* for erecting and stripping are only 19c per sq. ft. — that's economy!

This is the record of pre-fabricated UNI-FORM Concrete Panels used by Curtis Hancock in forming a final clarifier tank for the new 12 million dollar San Antonio, Texas sewage treatment plant expansion program.

In addition to UNI-FORMING the circular clarifier tank, Hancock used UNI-FORM panels to form four 30 ft. x 300 ft. aeration tanks, and a 1300 ft. concrete by-pass tunnel — approximately 135,000 sq. ft. of contact area in all.

In comparing the performance of UNI-FORM Panels on this job to a similar one done previously with forms he had built himself, Mr. Hancock estimates that he has saved at least four days in time alone!

It's performance like this that sells contractors and engineers on UNI-FORM panels. No other method of concrete forming can give you faster ground-to-ground forming speed, efficiency, flexibility, and economy. Why not investigate the advantages this modern concrete forming system can bring to you? Our strategically located Branch Offices and Distributors are ready to demonstrate and prove the advantages of UNI-FORM Panels to you. *Write for the new UNI-FORM Panel Catalog today.*

UNI-FORMED walls are clean, require little or no finishing.

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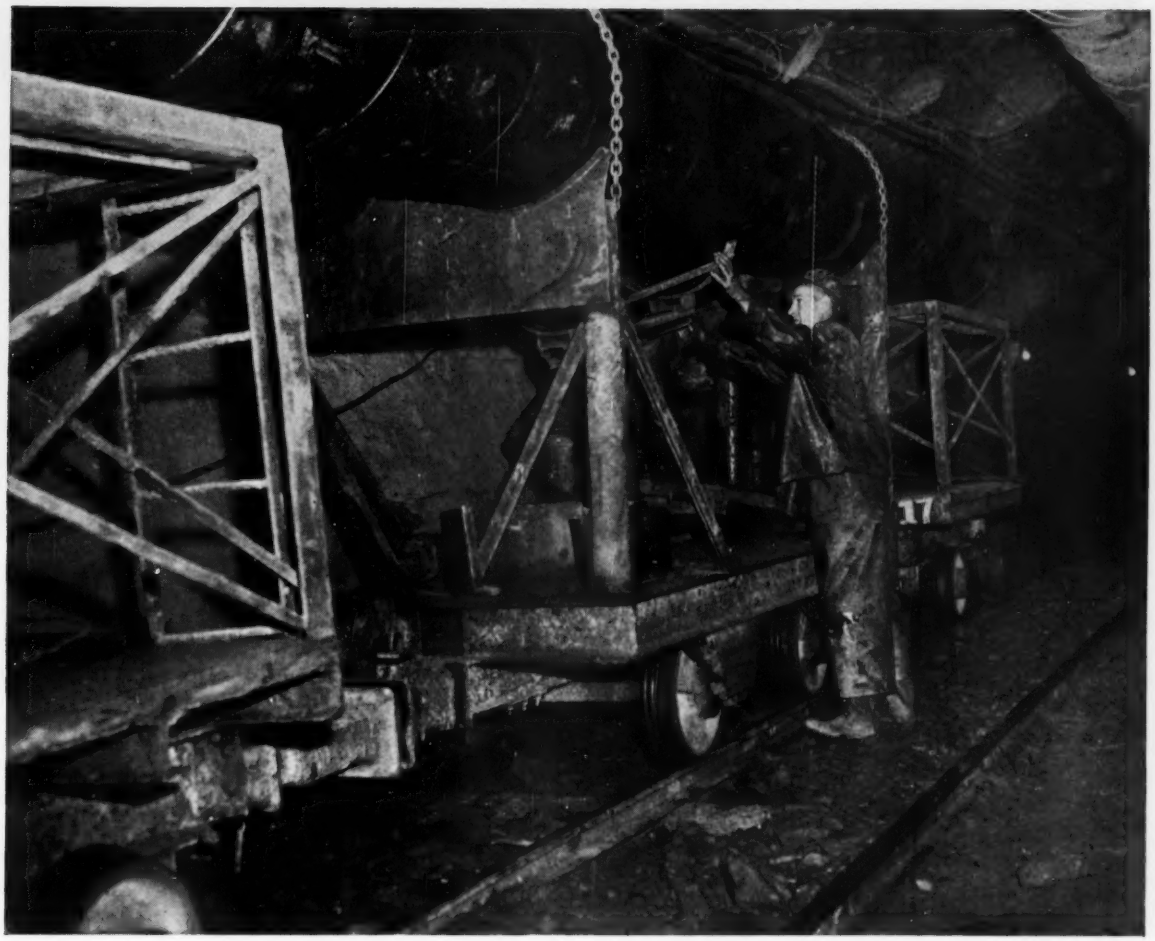

It's no problem to take fresh air with you in underground operations with NAYLOR large diameter pipe.

Lines of NAYLOR are easy to install because they are light in weight and easy to handle.

But don't let this light weight fool you. The NAYLOR spiral lockseam creates a pipe with the extra strength and safety needed for handling push-pull ventilating systems.

The one-piece NAYLOR Wedgelock coupling further simplifies the job and NAYLOR lines can be made up with only one side of the pipe in the open through this improved method of connection.

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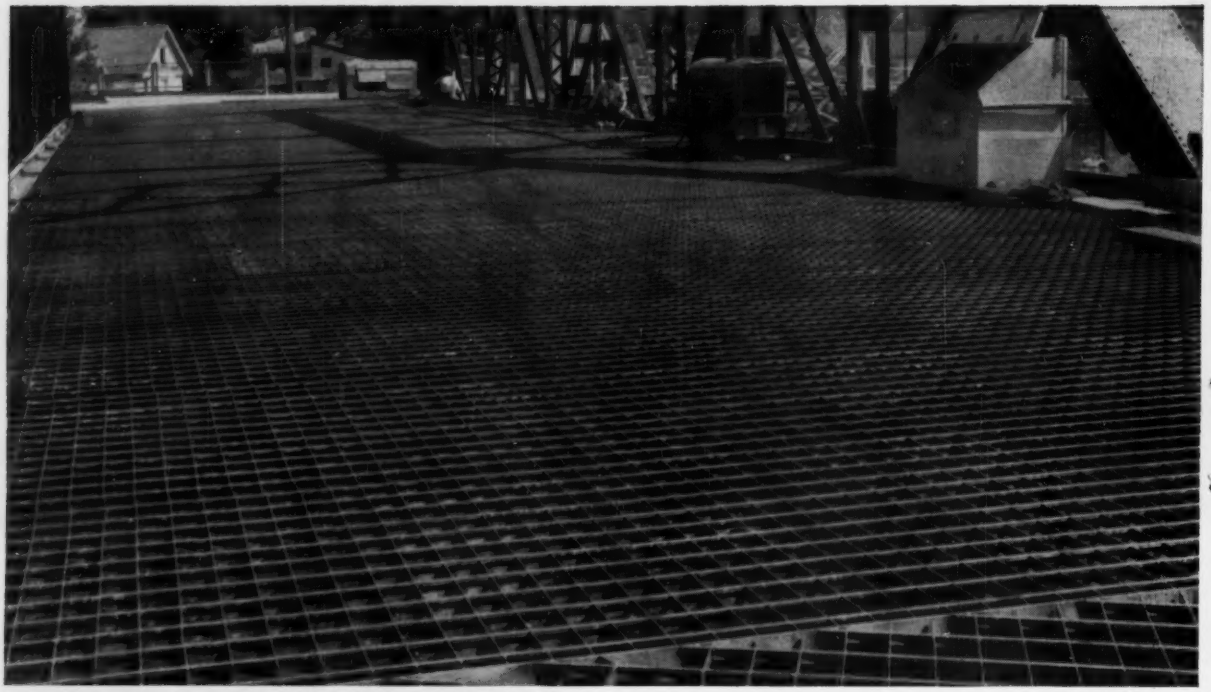

Carbondale, Pa. Bridge. High Welding Company, contractor. William P. Ross, job superintendent. This bridge has three approaches of various lengths and grades, and one 125′ main span. 4,900 sq. ft. of 4¼″ I-Beam-Lok (with ¾″ overfill) was laid on the main span, with 18,725 sq. ft. of 5″ open-type I-Beam-Lok placed on the three approach spans. Also, 1,000 sq. ft. of Tee-Type Sidewalk Flooring.

The old flooring on the 24′ roadway was made up of a layer of asphalt on 4″ brick, over a series of concrete arches between stringers varying in depth from 6″ at top of arch to 21″ at the stringer. While no accurate weight estimate was made of the complicated floor system, Mr. Ross figured that at most, the new open I-Beam-Lok steel floor weighed but 15% of the obsolete floor it replaced. *In other words, I-Beam-Lok reduced deadweight of approaches approximately 85%.*

In discussing this project, superintendent Ross said that in addition to the usual I-Beam-Lok advantages to contractors (speed of installation, ease of handling, and made-to-order working platform), the use of this lightweight steel flooring eliminated the necessity of working from below the bridge where both railroad tracks and power lines would have been encountered. Conventional construction would have required *two time-and-labor consuming operations—the placing of forms and then stripping them after pouring*—while I-Beam-Lok allowed all work to be performed top-side.

Superintendents on of reflooring

When you want information about a product, go out and talk to the men on an actual job. They deal with facts, not theory. They'll tell you exactly how it handles; whether it does what it is supposed to do; whether it solves problems, or causes them. That's why we visited the two reflooring jobs shown here. Both project superintendents are experts on reflooring old bridges. Incidentally, the men are brothers, and have been employed by the same contractor, High Welding Company, of Lancaster, Pa. for more than 20 years.

USS and I-Beam-Lok are registered trademarks

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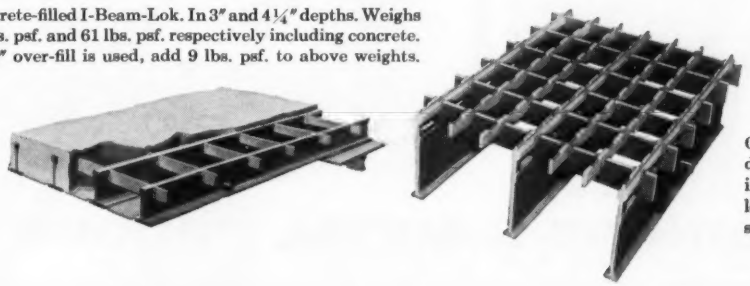
different jobs point out extra advantages old bridges with USS AmBridge I-Beam-Lok

Mulberry Street Bridge, Scranton, Pa. High Welding Company, contractor. Lester D. Ross, superintendent. This project involved reflooring an old bridge which carried two 23'6" roadways, 610' long, plus two 6' sidewalks. One of the roadways carried abandoned street car tracks; the other was paved with layers of asphalt, binder, and concrete piled to a thickness of 6 inches atop ⅜" steel buckle plates. All of which, together with the old tracks, had to be removed and replaced with 4¼" concrete-filled type I-Beam-Lok. (Some new beams and stringers were erected on both roadways.) A total of 31,000 sq. ft. of 4¼" concrete-filled type I-Beam-Lok was used for the roadway, plus 10,500 sq. ft. of 2" USS Tee-Type Sidewalk Flooring. (The roadway received a ¾" overfill.)

Commenting on this job, Lester Ross states that, in addition to the regular weight savings, speed of erection and ease of handling, another advantage was that the I-Beam-Lok was specially shaped with a 4" camber to fit existing beams, thus eliminating additional deadweight and framing problems.

Concrete-filled I-Beam-Lok. In 3" and 4¼" depths. Weighs 47 lbs. psf. and 61 lbs. psf. respectively including concrete. If ¾" over-fill is used, add 9 lbs. psf. to above weights.



Open-type USS I-Beam-Lok. 5" depth. Weighs 18.8 psf. Available in units 6'2" wide and up to 48' long. Can be applied directly to stringers.

For detailed information about this lightweight steel flooring, contact the nearest office, or write direct to Pittsburgh. Ask for a copy of our 32-page catalog.

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Laying a Texaco Asphalt FABC pavement on New Jersey's State Route 73, approaching the Tacony-Palmyra Bridge over the Delaware River. Route 73 is one of the most heavily traveled highways in south Jersey.

Contractors: Gaskill Construction Company and Union Paving Company.

Close-up of new FABC pavement constructed with Texaco Asphalt on Route 73 and view of completed highway under traffic.

New Jersey's answer is FABC

In New Jersey State Highway Department specifications, FABC stands for Fine Aggregate Bituminous Concrete. This dense, resilient, skid-resistant asphalt pavement has been constructed on heavily travelled primary highways of this state. Over the years its performance has furnished conclusive proof of its rugged durability, economy and unequaled riding quality.

Texaco asphalt has been used in the construction of a substantial mileage of New Jersey's FABC-paved highways and streets. Refined from scientifically selected crudes, Texaco has played an important part in enabling this hot-mix type of asphalt pavement to stand up under heavy, continuous impact, while holding maintenance costs down.

Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils offer the road builder a wide range of heavy-duty, intermediate and low-cost types of construction for roads, streets, airports and parking areas. Helpful information on all of these types is supplied in two free Texaco brochures. Copies can be obtained without obligation by writing our nearest office.

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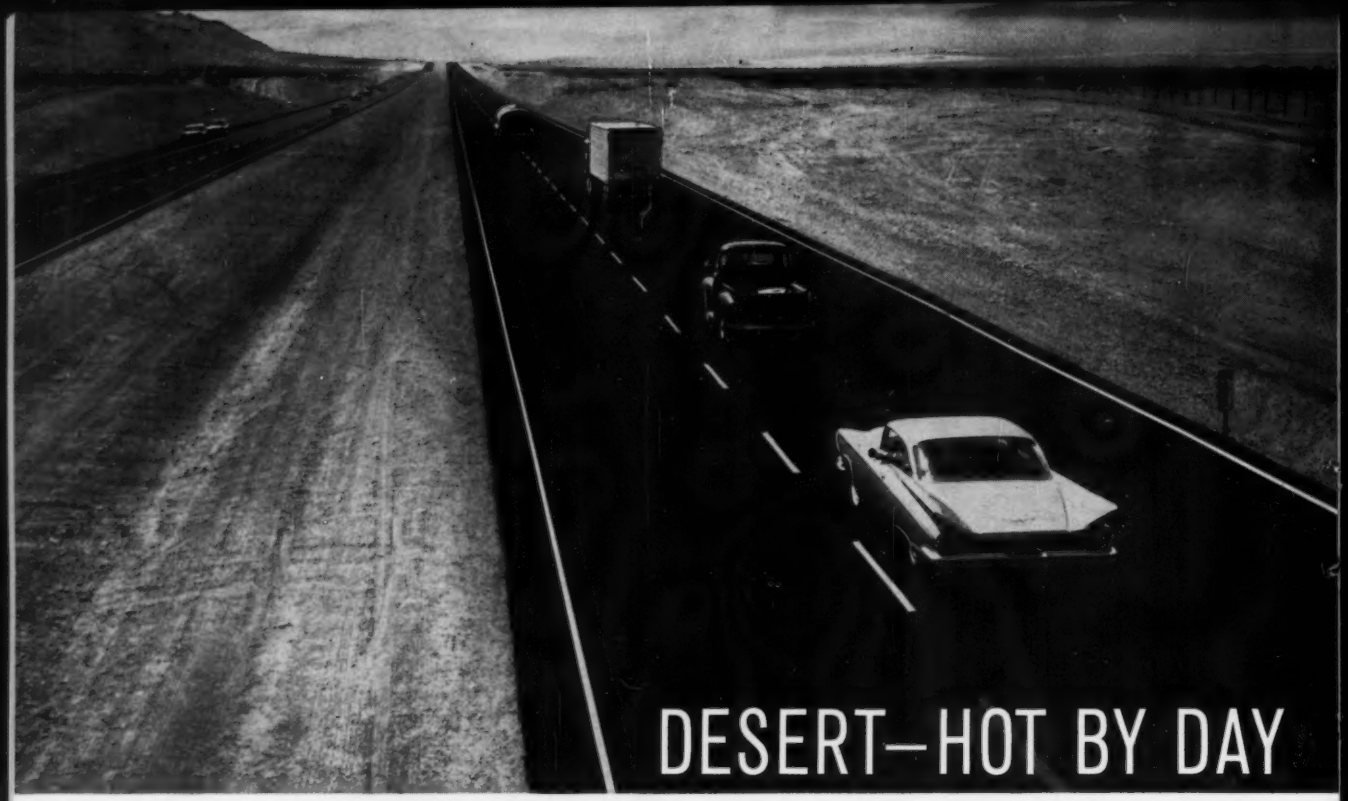
BETHLEHEM STEEL



Modern heavy-duty Asphalt pavement to endure years of heavy traffic

. . . solves problem of extreme variations of sub-soil bearing values, too.

Here's another Asphalt-paved Interstate highway.

Laid right through the heart of California's forbidding Mojave Desert, from Victorville to Barstow . . . this modern, heavy-duty freeway proves once again that no pavement is as versatile and economical and none is stronger or more durable than a well-constructed Asphalt-concrete pavement.

The project . . . 29.335 miles long . . . is one section in the planned conversion of U. S. 66-91 to Interstate Highway 15. Opened to traffic only last December, this outstanding Asphalt pavement already carries about one-fifth of all traffic between California and neighboring states. By 1980 it is expected to carry 33,600 vehicles per day at speeds up to 70 MPH . . . including some 2800 heavy-duty trucks.

This rugged Asphalt pavement **cost only half as much** as comparable concrete pavement to perform the same service.*

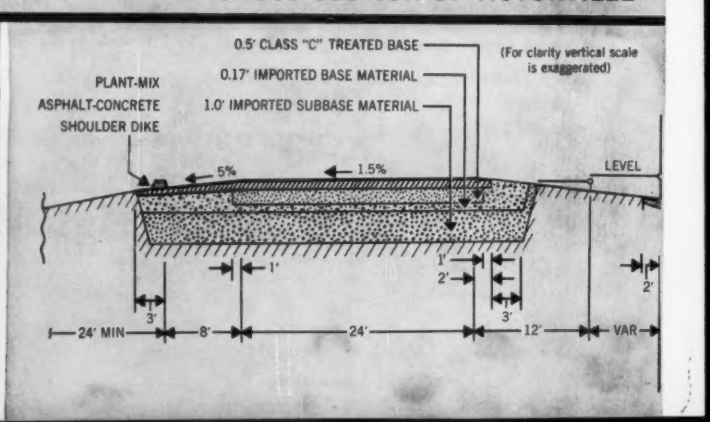
Asphalt design overcomes drastic temperature changes and varying soil conditions.

In the desert country between Victorville and Barstow, temperatures of pavement surfaces sometimes vary by as much as 140°F by day to freezing at night. Here, too, "R-Values"** of the soil vary from as low as 10 to as high as 75.

Asphalt-concrete shoulder dike prevents erosion, aids safety . . . may be placed quickly. To guide desert freshets to prepared drains and to provide a clearly defined shoulder edge, the design of the Victorville-Barstow project called for six-inch-high Asphalt-concrete shoulder dikes. Here you see one being placed at a rate of 24,000 feet per day by modern commercial equipment.

Asphalt-concrete pavement provides for a minimum of expensive materials . . . yet conforms to highest U. S. Bureau of Public Roads strength requirements for Interstate Highways. Notice below that 20 inches of

CROSS SECTION OF VICTORVILLE



DESERT—COLD BY NIGHT

on California Interstate 15 has ruggedness and drastic temperature changes

To provide a pavement of **predictable** strength and the durability to stand up under heavy traffic in the face of these drastic conditions, the engineers stripped top cover and constructed subbases and bases of required thickness and quality from nearby borrow.

In this heavy-duty but lower cost pavement, the wearing course is ½-inch of open-graded hot-mix Asphalt surfacing and the leveling course is 3 inches of dense-graded hot-mix Asphalt concrete placed in two courses 1½" thick. An Asphalt prime coat binds the leveling course to the base.

Construction speeds proved excellent... only 17 months to opening day... only 14 weeks to lay the 250,000 tons of Asphalt concrete. And the pavement is superbly smooth-riding.***

Modern Asphalt-concrete pavements... engineered and constructed like the Victorville-Barstow project... are **reputation builders** and **tax savers.** Sure to benefit you and your state for years to come! Specify Asphalt concrete for **your** Interstate highways.

*Based on comparable pavement costs in the same highway district.
**California-developed standard which compares soils on basis of their resistance to plastic deformation under load.
***Average Profile Roughness Index 2 inches per mile.

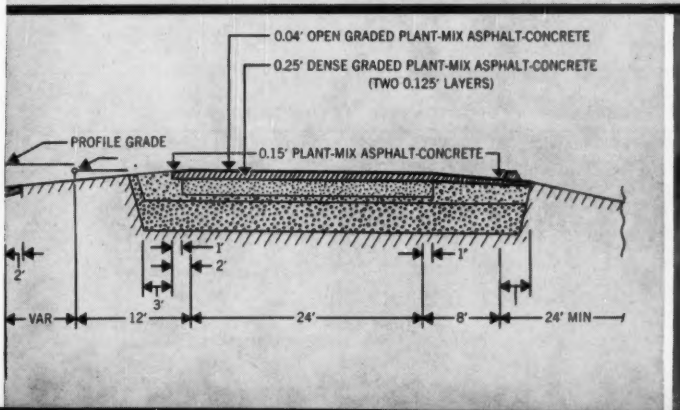
Ribbons of velvet smoothness...
***ASPHALT**-paved Interstate Highways*

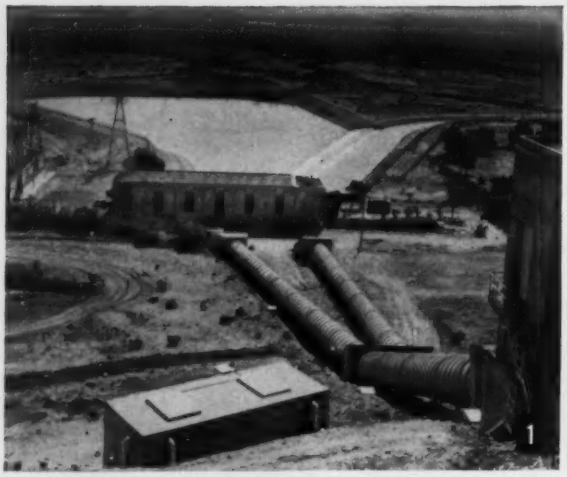
THE ASPHALT INSTITUTE
Asphalt Institute Building, College Park, Maryland

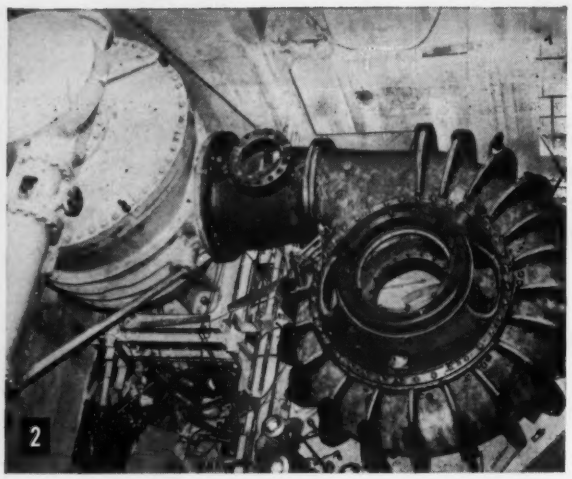
the 23½-inch pavement structure is low cost material imported from a local source. This same source supplied aggregate for the Asphalt plant mix at a relatively low cost.

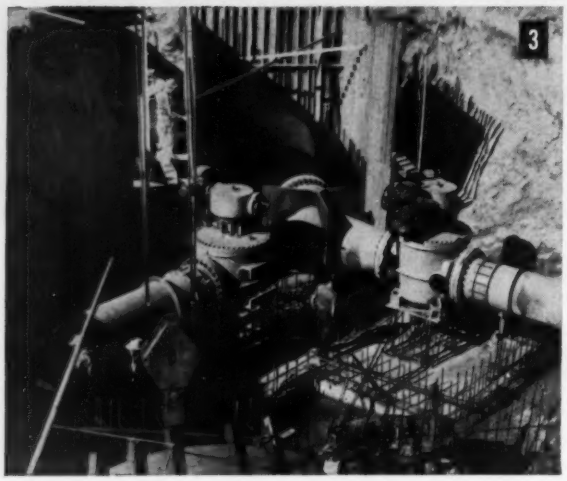
BARSTOW PROJECT, CALIFORNIA

Set of "doubles" speeds along Asphalt-concrete pavement in comfort and safety. Modern tax-fund-stretching Asphalt pavements are now being specified for many of the nation's heaviest-duty roads. Experience (with the New Jersey Turnpike, with jet plane runways, for example) proves these rugged, durable Asphalt pavements stand up under heaviest traffic.









1 Downhill view from Iron Mountain tunnel inlet on the Colorado River aqueduct shows the first two conduits and pumping station, with the reservoir and aqueduct in the background. Excavation at the right now houses a third set of pumps, and a third conduit has been added. Nine A-C Rotovalves are used here for pump discharge service.

2 Construction view shows 48" x 64½" tapered Rotovalve being installed with an Allis-Chalmers centrifugal pump at Iron Mountain Station.

3 Two 36" A-C Rotovalves connect to an energy dissipator on the Middle Feeder Line Discharge to the Alhambra Wash for ground water replenishment.

112 ALLIS-CHALMERS ROTOVALVES INSTALLED BY THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

A total of 563 Allis-Chalmers Rotovalves, in sizes from 6" to 64½", have been installed on water service throughout California in the last 25 years. The Metropolitan Water District of Southern California itself uses 112 of these Rotovalves in its Colorado River aqueduct and distribution systems. This aqueduct is part of a long-range program for increasing the water supply for the 7,000,000 people of the area it serves.

The flexibility of A-C Rotovalves suits them to any type of operation, any method of control, or any sort of location. In pump discharge service, the inherent characteristic of a large reduction of flow area during the early part of the closing stroke makes them ideally suited to control surges in the event of emergency shutoff. Full-line port opening means least possible pressure loss, and valve operation is quick and easy.

Allis-Chalmers offers you a complete line of Rotovalves, ball and butterfly valves for any water service. For full information, contact your nearest A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Penna.

Rotovalve is an Allis-Chalmers trade name.

Hydraulic Division RESEARCH · DESIGN · HYDRODYNAMICS · ENGINEERING · FABRICATION

Rotovalves • Ball Valves • Butterfly Valves • Free-Discharge Valves

Hydraulic Turbines & Accessories • Pump-Turbines • Pumps • Liquid Heaters

See us at the AWWA Exhibit
San Francisco, July 12-17
Booths 67 to 69, 78 to 80

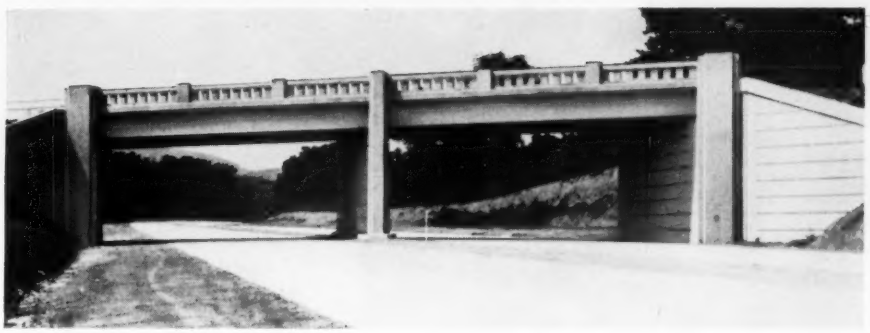
AC ALLIS-CHALMERS **ALLIS-CHALMERS**

1105

Complex Interchange...

Four-level reinforced concrete Los Angeles Freeway separation structure

Or a Simple Bridge...



Simple girder reinforced concrete bridge in Bedford County, Pennsylvania

You can stay on schedule when you design in

Reinforced CONCRETE

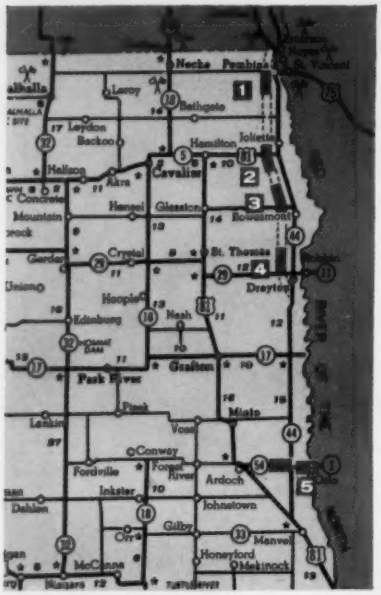
For every complex multiple overpass in use today, there are a thousand or more simple bridge structures. Whether the bridge design problem be complicated or simple, highway engineers are finding reinforced concrete the logical, economical solution.

Reinforced concrete provides a construction material of unusual flexibility and durability. On your next bridge or multiple overpass, design for beauty plus economy . . . and stay on schedule with REINFORCED CONCRETE.

CONCRETE REINFORCING STEEL INSTITUTE CRSI FOUNDED 1924

Concrete Reinforcing Steel Institute
38 South Dearborn Street, Chicago 3, Illinois

MAP showing locations of North Dakota's new Interstate Route 29 and State Route 54. Major bridges over the Pembina River at Pembina and over the Red River at Oslo, Minnesota, will be steel structures fabricated by the American Bridge Division of United States Steel. Others will be concrete on USS Steel H-Piles.



CONTRACTORS:

SITE 1: Swingen Construction Co., Grand Forks, N. D.
SITE 2: Otto J. Eickhof & Sons, Inc., Crookston, Minn.
SITE 3: Wm. Collins & Sons, Inc., Fargo, N. D.
SITE 4 & 5: Schultz & Lindsay Construction Co., Fargo, N. D.

180 feet down. Welding plate on USS H-Pile which will be spliced to a pile already down. At this site, they drive piling 180 feet to reach firm footing.

USS Steel H-Piles pay off for North Dakota they now have stable foundations

North Dakota State Highway Department Bridge Engineers have been struggling with a baffling foundation problem for years. Recently, together with Minnesota Highway Department Bridge Engineers, steps were taken to find a solution. The valley area of the Red River which forms the northern portion of the boundary between these two states was once a lake but is now filled with a tremendous quantity of unstable clay to a depth of 180 feet or more.

Previously, bridges constructed in this area had been placed on displacement-type piles or on floating foundations. While neither of these methods was very satisfactory from the performance standpoint, there seemed to be no economical alternative. It was accepted as fact that periodic repairs would be necessary to correct for the deficiencies of these foundation supports. High maintenance costs appeared inevitable.

When the new Interstate Highway and other state projects were planned through the area, it was obvious that stable foundations would be needed for fourteen bridges involved. So in 1957, the North Dakota Highway Department in collaboration with the Minnesota Highway Department and the Bureau of Public Roads had test borings made in various locations. They found, at a level assumed to be the original lake bed, a mixture of gravel, clay and sand, which seemed dense enough to support piles in point bearing. Five test piles were driven and loaded. Test loads of 250 tons were successfully applied to 14", 73- and 89-pounds-per-foot USS Steel H-Piles. (Displacement piles had once been driven 80 feet into the overlying soil to attain a bearing value of only 12 tons per pile.) Working loads of as high as 90 tons per

Splicing two H-piles with diamond shaped plate. Ample strength is obtained.

Driving H-piles for the new Red River Bridge near Oslo, Minn. Previously, bridge foundations in this area were set on slabs or displacement piles.

and Minnesota . . . for 14 new bridges

89-pound pile were thus substantiated by these tests and subsequently incorporated into the final design. A total of 2,100 tons of USS Steel H-Piles were driven for these bridges.

The bridge engineers are well pleased with the results of this program. They saved additional money on the minor bridges by designing the intermediate piers to utilize piles encased in concrete as bents to support the bridge structure. They like the way the piles drive without damage, the easy splicing, and the assurance that their foundations will finally stay put.

Quick Deliveries. United States Steel is in excellent position to give you favorable deliveries on steel H-piles or steel sheet piling of any type. Write to any of our district offices or United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. *USS is a registered trademark*

USS

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Export Company

United States Steel

NEWS OF ENGINEERS

Francis E. Twiss has been appointed new Deputy Director for Traffic Engineering and Operations in the Department of Highways and Traffic, Washington, D. C. Mr. Twiss has an extensive background and knowledge to apply to Washington's complex traffic picture. He is a former professor of traffic engineering at Yale and engineer advisor to the Associated General Contractors of America.

Ritchie Lawrie, Jr., partner in Lawrie & Green, architectural-engineering firm in Harrisburg, Pa., received the fifth annual award "for outstanding service to competitive enterprise" of the Americans for the Competitive Enterprise System at a recent joint meeting of ACES and the Rotary Club of Harrisburg.

Clement F. Egger, formerly employed for eight years by Black & Veatch, consulting engineers of Kansas City, Mo., is now city engineer of Paola, Kans. Under his jurisdiction are maintenance and new construction on the city's fifty-seven miles of streets, the municipal water system, sewage treatment plant, and the multiplicity of other jobs that fall to any city engineer.

David M. Smallwood, Philadelphia streets commisioner, has received an American Public Works Association Meritorious Service Award. Mr. Smallwood was especially cited for his work in the planning and execution of the city's highway program as chief of the Highway Division and as streets commissioner.

D. B. Steinman at the honors convocation at Hunter College in New York City on April 29 was presented with the President's Gold Medal for Distinguished Service. On June 1 Syracuse University will award Dr. Steinman, internationally known bridge engineer, the honorary degree of doctor of engineering, his twentieth doctorate.

Thomas M. Stetson announces the establishment of engineering offices in the Haas Building, 219 W. Seventh Street, Los Angeles. The firm will specialize in consultation, investigation, appraisals and reports regarding water supply and development, surface and ground water hydrology, flood control and drainage, and related engineering fields. Mr. Stetson has filled a variety of important hydraulic engineering posts and is currently consulting engineer to the California Department of Justice on Colorado River litigation.

Earle B. Butler, Colonel, Corps of Engineers, is the new Buffalo district engineer. In this capacity he will be responsible for all design work on the St. Anthony Falls and the new Poe Lock, which will cost approximately $60 million. His duty as Buffalo district engineer follows a fourteen-month assignment in Korea.

H. R. Angwin received the Department of Commerce Award for Meritorious Service on his recent retirement from the Bureau of Public Roads after forty years of government service—thirty of them as chief Western bridge designer in the San Francisco office. His position has been filled by **David M. Goodall,** who was transferred from the Bureau's Portland, Ore., office, where he was senior highway bridge engineer.

William J. Wallace, recently retired engineer of streets for the City of Detroit, has been appointed asphalt paving consultant for the Michigan Asphalt Paving Association in the Detroit metropolitan area.

Arthur H. Frye, Jr., formerly deputy engineer for the U. S. Army Japan, was recently named engineer. His last appointment before assignment to the Far East was as district engineer for the Los Angeles District of the Corps of Engineers from 1953-1957.

Ellis Danner, professor of highway engineering at the University of Illinois, was recently elected to the four-member Champaign (Ill.) City Council. Professor Danner just completed a term as president of the Central Illinois Section. **John W. Briscoe,** another member of the civil engineering staff at the university, has been an alderman on the Urbana City Council since 1957. Professor Briscoe is assistant department head in the Department of Civil Engineering.

Charles A. Maguire & Associates, engineers with offices in Providence, R. I., and Boston, Mass., announce admission to the firm as associates of the following: **Harold Bateson,** project engineer; **Robert L. Pare,** chief bridge engineer; **Francis C. Pierce,** senior foundations engineer; and **Eric Reeves,** structural engineer. **Edward O. Greene,** civil engineer, will act as a special consultant to the firm.

Frank Leslie Thompson is retiring as senior civil engineer with the New York City Board of Water Supply, rounding out thirty-four years of continuous civil service, the last twenty-two with the Board. Mr. Thompson expects to engage in the private practice of engineering as an associate partner in the firm of Slingerland & Booss.

John J. Hennigan, Jr., assistant professor of civil engineering at Syracuse University, will become associated with the firm of K. G. Woodward & Associates, consulting engineers of Webster, N. Y., in June. Mr. Hennigan was formerly assistant city engineer in Summit, N. J., and director of sanitation for Syracuse, N. Y.

Theodore V. Galambos for the past three years research associate at Lehigh University, Bethlehem, Pa., has been named research assistant professor of civil engineering. The promotion takes effect July 1.

Harold P. Cohn and **Ralph P. Pass,** of the Whiting-Turner Contracting Company, of Baltimore, Md., were recently promoted from division managers to vice

H. P. Cohn

R. P. Pass

presidents. Both men joined Whiting-Turner in 1947, Mr. Cohn becoming division manager in 1954 and Mr. Pass, Midwestern division manager in 1955.

(Continued on page 30)

News of Engineers

(Continued from page 29)

Roy Kuykendall, after twenty-seven years of government service, recently retired to accept a position with Sverdrup & Parcel International, Inc. in Bangkok, Thailand. Most of Mr. Kuykendall's government career has been with the Bonneville Power Administration in Portland, Ore.

John C. Richardson recently joined the staff of the Tonawanda (N. Y.) Laboratories of the Linde Company, a Division of Union Carbide Corporation, and is presently working in the Acetylene Design Section of the Engineering Laboratory. He previously worked at the Linde Speedway (Indianapolis), Indiana Laboratories.

Earl W. Homan and **Richard D. Lawrence** announce the formation of a new company to be known as Homan and Lawrence Engineering Company with offices at 1295 Folsom Street, San Francisco, Calif. Mr. Homan is leaving the Macdonald Engineering Company where he has been president of their California corporation since 1947 to head up the new organization.

Three ASCE members were cited for outstanding accomplishments in their fields at the eleventh annual Wisconsin Engineers' Day celebration on the University of Wisconsin campus May 1. They are: **Ralph E. Davis,** president of Ralph E. Davis Associates, Houston, Tex., and a recognized authority on natural gas reserves; **Martin W. Torkelson,** executive officer of the Wisconsin State Planning Board in Madison, with fifty years in public service as an engineer and executive; and **Charles S. Whitney,** partner in the New York and Milwaukee firm of Ammann & Whitney, and engineer on many notable projects.

John G. Hendrickson, Jr., formerly research engineer for the American Concrete Pipe Association and the American Concrete Pressure Pipe Association, in Chicago, Ill., has been promoted to director of engineering-research of both associations.

Leroy Martin, partner in the AAA Engineering Company, of Hayward, Calif., has been appointed executive secretary of the California Society of Professional Engineers. He is a registered civil engineer in California and a registered professional engineer in Texas and Hawaii.

J. P. Naegamvala has been appointed the first director of the Central Engineering Research Institute recently established by the Bombay Government at Nasik, India, an adjunct of the Public Works Department. Mr. Naegamvala was formerly professor and head of the Department of Engineering of the College of Engineering at Poona.

Edward A. Miller, vice president of Fenestra Inc., pioneer Detroit building products manufacturer, has been elected executive vice president. In his new capacity he will continue to be in charge of the firm's building products division.

M. C. Patton, executive vice-president of Armco Drainage and Metal Products, Inc., Middletown, Ohio, has been named chairman of the board. He has been with

M. C. Patton

W. S. Mann

Armco since 1926, and has been executive vice-president since 1947. **Warren S. Mann,** vice-president and manager of Armco's Dixie Division in Atlanta, Ga., has been made vice-president of sales.

Tippetts-Abbett-McCarthy-Stratton, engineers and architects, have moved to 375 Park Avenue, New York 25, N. Y.

Alvin G. Viney, Major General, Corps of Engineers and Deputy Chief of Engineers for Military Operations since 1957, retired from active service on May 15. General Viney, during his thirty years as an officer in the Corps of Engineers has had responsibility for military operations, supply and procurement, research and development, nuclear power, mobilization and operational planning, intelligence and mapping, organization and training of troop units, and military and civilian personnel administration.

Harold L. Nelson, of Albany, N. Y., has been named Northeastern sales representative for the Prescon Corporation, Corpus Christi, Tex. Mr. Nelson has a background in prestressing and several years' experience as bridge engineer with the Alaska Road Commision, where he was field engineer on contract bridge construction, and engaged in design of all types of steel and timber bridge structures.

Martin P. Korn was named a consultant to the Prestressed Concrete Institute at its recent meeting in New Orleans. Colonel Korn, who is currently executive secretary, will take over his new duties in January 1960. The present assistant executive secretary, **Norman L. Scott** will succeed Colonel Martin as executive secretary.

W. J. Koenig, manager of the Esso Construction and Maintenance Division in New York since 1954, recently transferred to the Standard Oil Company (N. J.), Esso's parent company, where he is manager of the engineering section of the marketing coordination department.

Walter J. Gress, who is retiring from the New York City Board of Water Supply after thirty-four years of service as department engineer, was honored at a recent testimonial dinner. Instead of retiring to a life of leisure and the pursuit of hobbies, Mr. Gress will be chief construction engineer of the Division of Water Policy and Supply which he is organizing under the Department of Conservation and Economic Development in New Jersey.

Burton A. Scheidt has been appointed chief engineer of the Metropolitan Sanitary District for Greater Chicago. He will succeed **Horace Ramey,** who resigned recently after fifty-one years with the district. Mr. Scheidt has been with the district for thirty-four years, and last year was named engineer of construction.

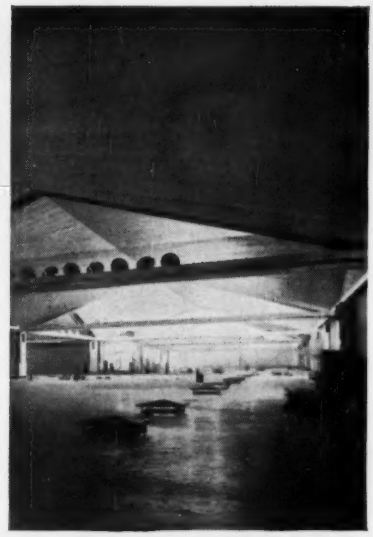
T. M. Leps, chief civil engineer for the Southern California Edison Company in Los Angeles, Calif., for the past eight years, has been appointed manager of organization and procedures for the electric utility company. Succeeding Mr. Leps is **R. W. Dennis,** the company's assistant to the chief structural engineer.

Harry B. Tour, for many years head architect for the Tennessee Valley Authority at Knoxville, Tenn., has just been elected as Fellow of the American Institute of Architects.

M. H. Cutler was recently named engineering manager of the Stone & Webster Engineering Corporation, of Boston, Mass., and New York, N. Y. Mr. Cutler has served as assistant engineering manager and chief structural engineer since joining the firm in 1923.

Three members of the University of Illinois civil engineering department have been selected as the 1959 winners of the A. Epstein Memorial Award. They are **George W. Hollon,** assistant professor, and **Narbey Khachaturian** and **Robert J. Mosborg,** both associate professors. The awards are made to outstanding young staff members on the basis of personal achievement, scholarship and professional standing, distinction in public service, and general overall contribution to the prestige of the university.

(Continued on page 33)



Hyperbolic paraboloid roof gives 63-ft. wide, unobstructed bays

The roof of the Texas Instruments plant consists of many units, each made up of four similar quadrants cast to form horizontal ridges at the top. Corners of each unit are supported on separate columns. Each unit is structurally independent. Shells are uniformly 3″ thick, except in the vicinity of edges and ridges.

Concrete V-tetrapods form space truss between floors

Four-legged, 5,000 psi precast concrete tetrapods act as diagonals for an 8-ft. deep space frame formed with upper level floor slab and lower level prestressed ceiling slab. The truss formed resists heavy shear forces, retains flexibility of utility arrangement.

Consulting engineer on shells: Felix Candela. Consulting engineer, general structure: Wallace Wilkerson.

For free literature *on shell construction (distributed only in U. S. and Canada) write to Portland Cement Association, Dept. A6-13, 33 West Grand Ave., Chicago 10, Illinois.*

News of Engineers

(Continued from page 31)

Richard Hazen, of the consulting engineering firm of Hazen and Sawyer, New York; **Charles B. Molineaux,** vice president and chief engineer of Arthur A. Johnson Corporation, New York; and **William H. Wisely,** Executive Secretary of ASCE, have been appointed consultants to the Council on Engineering Affairs of Manhattan College. Since its inception in April 1957, the Council has been engaged in designing a new program consisting of four curricula leading to degrees in chemical, civil, electrical and mechanical engineering, with increased emphasis on the importance of the humanities.

John A. Garrard will be president of the new firm of Garrard-Warren, Inc., general engineering contractors with offices in San Jose, Calif. The firm's scope of operation includes excavation, grading and paving, underground pipe lines, and flood control work. Mr. Garrard during the past five years has worked for C. J. Wood, Inc., Redwood City, Calif., as estimator, project manager, and vice president.

Robert L. Kennedy has been invited by the Chicago Housing Authority to serve on a special committee in his capacity as president of the Illinois Section of ASCE. The committee will analyze construction costs for new projects in the Chicago area to determine how it can hold down costs in an inflationary spiral that is threatening a program of 10,000 new public housing dwellings. Mr. Kennedy is an associate in the Chicago office of Hazelet & Erdal.

George H. Henderson, who is said to have had more to do with the development and construction of Rhode Island highways over nearly half a century than any other person recently retired from the state service. He became chief of the Division of Roads and Bridges under the Rhode Island Department of Public Works in 1939, a position he has held ever since.

G. William Bailey and **Warren N. Riker** have been elected vice presidents of Raymond International Inc., of New York City. Mr. Bailey, who has been Raymond's chief engineer since 1954, will

G. W. Bailey

W. N. Riker

take charge of a newly established Heavy Construction Division, organized to manage special domestic construction projects. Since 1957 Mr. Riker has been project manager on special construction work in the Middle East.

Elmer B. Stevens has been named resident engineer of the Panama Canal Company in charge of the construction of the bridge over the Panama Canal at Balboa. From 1950 until April 1 of this year, Mr. Stevens served as chief of the Structural Branch in the company's Engineering Division.

Leif J. Sverdrup, president of Sverdrup & Parcel, architects and engineers of St. Louis, Mo., was recently awarded the Lloyd Kimbrough Medal of the American Institute of Steel Construction for "outstanding achievement in the engineering and design of steel-frame structures." These include bridges in Missouri and Nebraska, airfields, the Saudi Arabian oil pipeline and auxiliary facilities, and the Arnold Engineering Development Center built for the Air Force in Tennessee. General Sverdrup is the third person to receive the award since it was established in 1938.

Harold V. Owens was recently appointed by Governor Rockefeller to the board of trustees of the Mohawk Valley Technical Institute in Utica, N. Y. Mr. Owens also is president of Eastern Rock Products, Inc., and secretary and treasurer of the Dale Engineering Company.

C. H. Ferguson recently left Intrusion-Prepakt, Inc., where he was regional manager in the San Francisco, Calif., office to join the Boeing Airplane Company in Seattle in its Pilotless Aircraft Division.

David E. Fleming, structural engineer with the U. S. Bureau of Reclamation in Denver, Colo., has become an associate in the Denver firm of A. J. Ryan and Associates, Inc. Other associates of the firm are: **Alfred J. Ryan,** consulting engineer; **Albert T. Knuckey,** chief engineer; and **Herbert F. Hall,** associate engineer.

Gilbert M. Nelson has joined the staff of the Benjamin E. Beavin Company of Baltimore, Md. He goes to the Beavin company after varied engineering experience with the J. E. Greiner Company, of Baltimore.

Eugene Sembler was named the "outstanding junior citizen of the year" by the Galveston, Tex., Junior Chamber of Commerce at its recent annual awards banquet. Mr. Sembler is chief engineer of the Galveston Wharves.

Melvin F. Wood, assistant chief engineer of the DuPont Company for the past thirteen years, was recently made chief engineer. Mr. Wood joined the DuPont Company in 1928 as assistant construction superintendent in the engineering department, and served in various capacities before becoming assistant engineer in 1946.

BIG AD CAMPAIGN WARNS OF GROWING WATER PROBLEM!

Urges local support for better water systems

CAST IRON PIPE RESEARCH ASSOCIATION OFFERS LOCAL PLAN-OF-ACTION BOOKLET

Here's help for consulting engineers and everyone else directly concerned with the supply, treatment and distribution of water—help that will acquaint the general public and community leaders with the vital importance of this growing problem.

On the opposite page you see the second in a series of advertisements, this one appearing in April *Reader's Digest*. Placed by the Cast Iron Pipe Research Association, these striking advertisements point out to Mr. and Mrs. America how much we depend on a good water system and why we can no longer take it for granted.

Similar advertising will appear regularly in *U. S. News & World Report, Nation's Business, Better Homes & Gardens, American Home* and *Sunset* magazines to carry this public service message to millions of civic leaders and homeowners.

FREE LOCAL HOW-TO-HELP BOOKLET

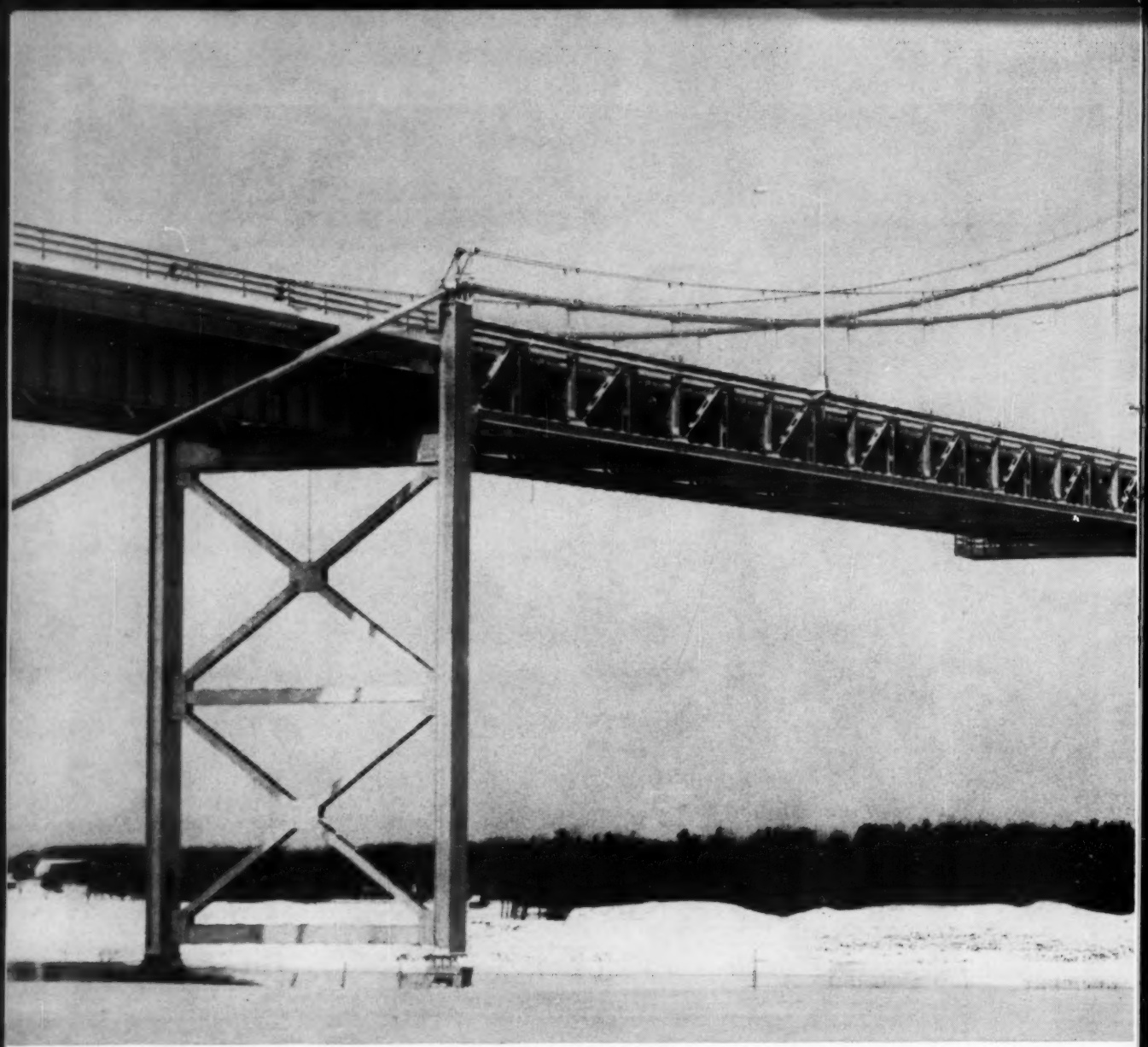
These ads offer a free booklet telling about the water problem. It shows how responsible citizens can acquaint themselves with the needs of their community. It also gives a step-by-step outline of action, telling how they can help their officials extend and improve the local water system through more adequate rate structures or financing.

Let us send you a free copy of this new booklet. Write to Thos. F. Wolfe, Managing Director, Cast Iron Pipe Research Association, 3440 Prudential Plaza, Chicago 1, Ill.

THREE REASONS WHY CAST IRON PIPE IS *AMERICA'S GREATEST WATER CARRIER:*

1. More miles of underground cast iron water mains are now in use than of all other kinds of pipe combined.
2. More miles of cast iron water mains are now being purchased and laid than of any other kind of pipe.
3. Impartial surveys prove that today's consulting engineers and water utility officials prefer cast iron pipe for underground water distribution by an overwhelming majority.

CAST IRON PIPE

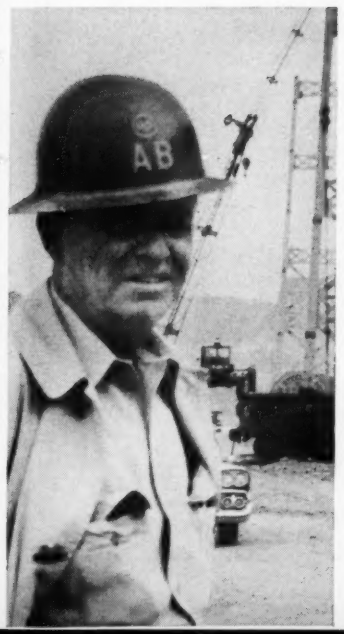


New St. Lawrence Bridge erected in 6 months!

This modern structure spans the south channel of the St. Lawrence River between the New York shore and Canada's Cornwell Island. It replaces an old bridge that was too low for seaway ships.

On May 14, 1958, erectors placed the first steel member for the 3,480 ft. bridge with its 1,800 ft. suspension section. The 215-ft.-high towers were erected in 21 working days. The suspended span too was completed in 21 days. The cables (spun at American Steel & Wire's Trenton Works) were installed in just 12 days. Other phases of the job moved equally fast.

On November 14, 1958, exactly 6 months after construction began, more than 3,400 tons of structural steel and 454 tons of wire rope were in place, and the bridge was ready for traffic.



A record? Maybe. But to the man who finished Mackinac, this is just

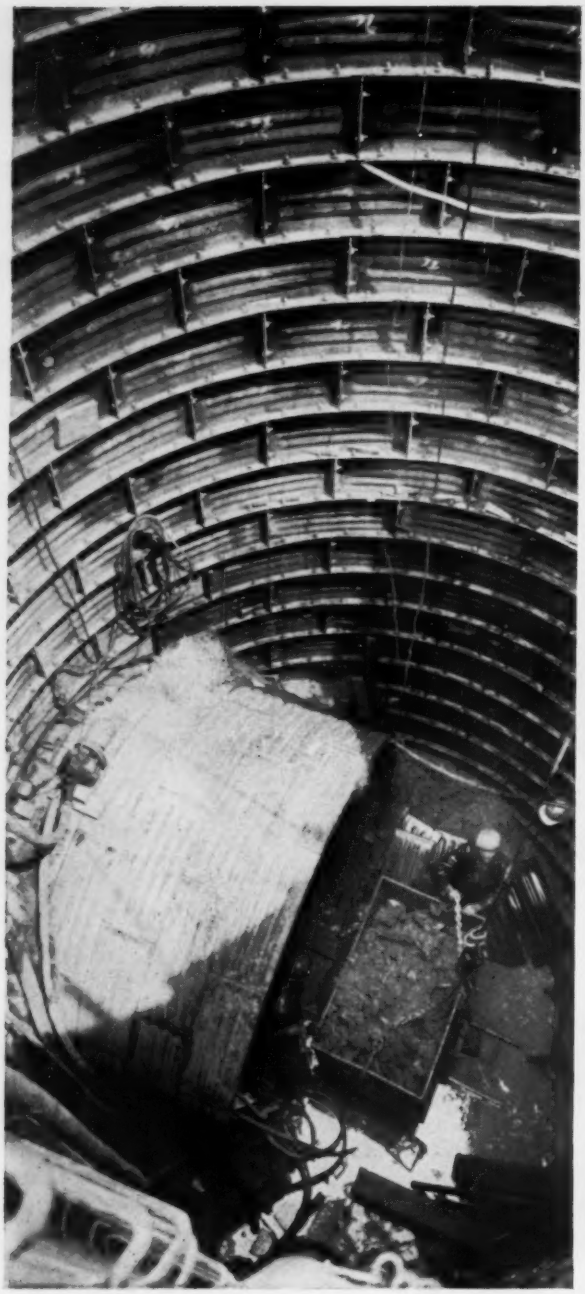
another fast job by American Bridge

Art Drilling came directly to the St. Lawrence project after finishing the Mackinac Bridge on time—in record time. Like our other steel construction specialists, Art makes a habit of doing a job right—and right on time.

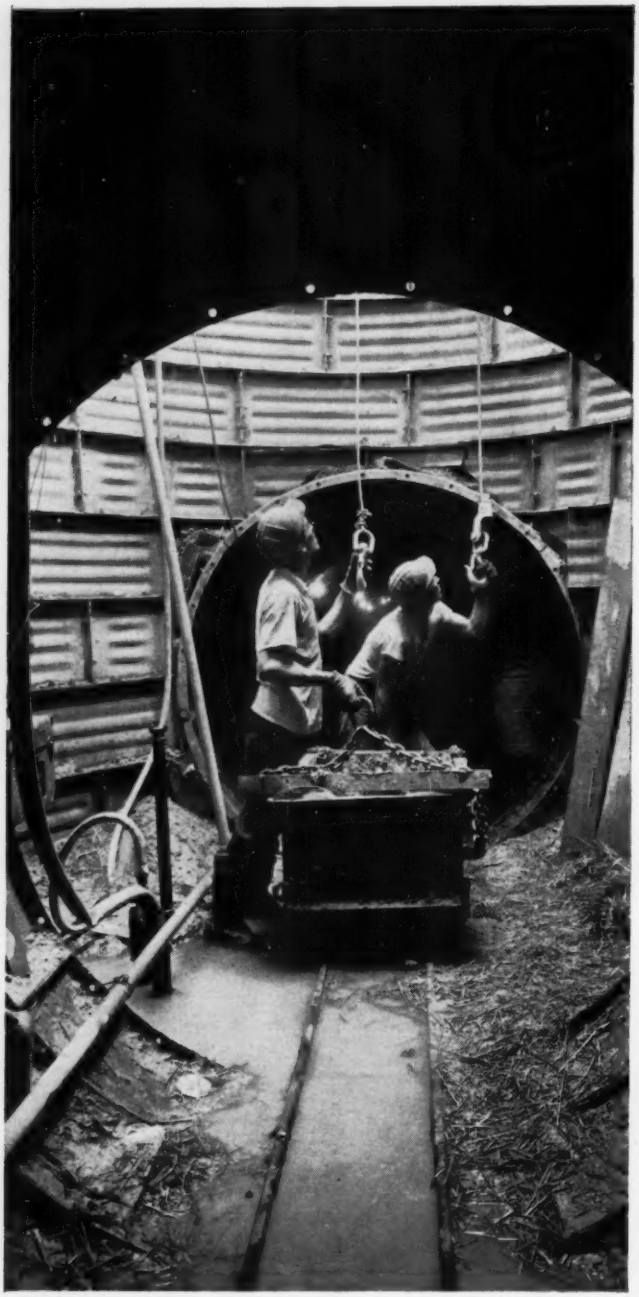
American Bridge Division of USS United States Steel

General Offices: 525 William Penn Place, Pittsburgh, Pa. • Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham • Boston Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Elmira • Gary • Harrisburg, Pa. • Houston • Los Angeles • Memphis Minneapolis • New York • Orange, Texas • Philadelphia • Pittsburgh • Portland, Ore. • Roanoke • St. Louis San Francisco • Trenton • United States Steel Export Company, New York

Faster, safer tunneling and how it's



COMPLETED IN 3 WORKING DAYS—352 COMMERCIAL tunnel liner plates reinforce 192" diameter, 30 feet deep, initial access shaft for Tousley Construction Co. section of the sewer project. As vertical shaft bored downward, the 16" x 37 11/16" tunnel liner plates were successively secured in position with 3/4" bolts.



UNCLUTTERED WORKING AREA at Thompson Construction Co. access shaft permits easy entry into tunnels and allows fast removal of 5/8 cubic yard mucking bucket loaded with chunks of hard-packed blue clay from tunnel heading. Bucket is lifted and dumped at surface by crane equipped with 35 ft. boom.

being done

Steel liner plates produced by COMMERCIAL for speedier assembly and greater safety factor *prove unanimous choice* of two different contractors on $1,710,000 Indianapolis storm interceptor sewer project.

Contracts for the nearly two miles of tunneling involved in the East Michigan Street storm sewer job at Indianapolis, Indiana were awarded to two separate firms. And here's what they had to say about their independent choice of COMMERCIAL steel tunnel liner supports:

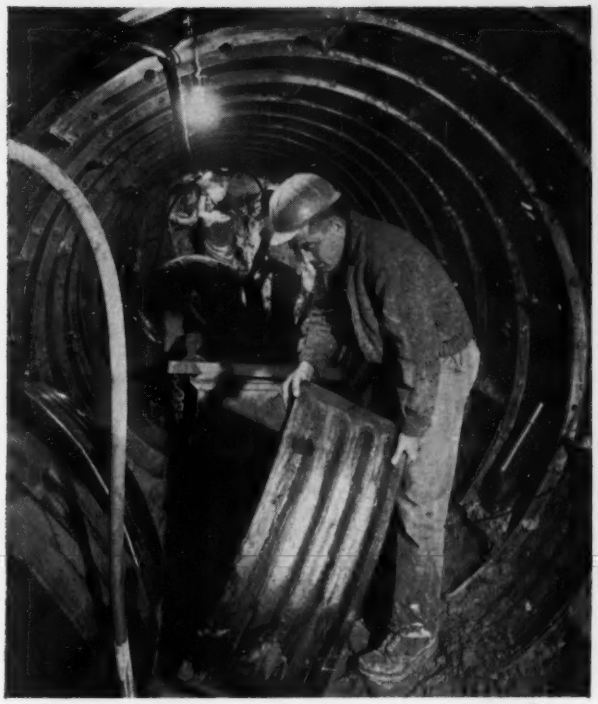
"No other liner plate can compare with COMMERCIAL for easier and faster installation and assembly," says Mr. Porter Williams, Secretary of the Thompson Construction Company. "And among all steel tunnel liner designs, we are firmly convinced there is none safer than COMMERCIAL's," he added.

"We have been using COMMERCIAL tunnel liner plates exclusively for three years," commented Mr. Don Bixler, President of the Tousley Construction Company. "Their consistent size and uniformity simplifies placement and speeds fastening," he continued.

The Thompson Construction Company is handling 5400 feet of the tunnel project—two sections of 48″ and 84″ in diameter. Both sections are being tunneled simultaneously but in opposite directions through hard-packed blue clay soil. The 84″ diameter tube will house a 60″ I. D. pre-cast concrete pipe, while the 48″ section will enclose a similar 18″ pipe. Space between pipe and liner shell will eventually be filled with concrete. In addition, twelve 21 ft. deep vertical shafts, each fitted with manholes for future access, will be dug at strategic points along the complete length of the tunnel.

The Tousley Construction Company, on another contract, is constructing 4500 feet of tunnel, 900 feet of which will be 10 ft. in diameter and the balance of 3600 feet 11 ft. in diameter. Pre-cast concrete pipe 96″ and 102″ in diameter will eventually line the entire tunnel. Progress on the job, which will also include six 30 ft. deep vertical shafts for future access, is moving along at the rate of 12 feet per day in spite of the hard-packed blue clay and water seepage complications involved.

For more complete details on how COMMERCIAL steel liner plate can simplify and speed up your vertical shaft, surface or sub-surface tunnel project—help make it safer—send today for your copy of Bulletin 300-CI. With over 25 years experience in the design of supports for soft ground or rock excavation, COMMERCIAL's engineers may be able to suggest a more workable and economical solution to your particular support design problem whatever it may be. Address: Commercial Shearing & Stamping Company, Dept. C-23, Youngstown 1, Ohio.



10 FEET PER DAY is average rate of progress in each of the concurrent Thompson tunnels. As fast as mucking operation progresses, 3/16″ thick COMMERCIAL liner plates are rapidly installed by the head miners. The size and uniform shape of the plates facilitate their storage alongside mucking car tracks.

NO OUTSIDE BOLTING—Deep flange which surrounds all four sides of COMMERCIAL plate eliminates this hazard. All head miner does is to position plate, line up accurate pre-punched bolt holes, insert 3/4″ quick acting bolts and tighten nuts with a pin wrench. No fear of loose fit because inside through-flange connections eliminate need of outside support for bolt heads.

Our community needs a new school.

We need it in a hurry.

We want a sturdy, attractive building.

We want fire safety for our children.

We want a building that's easy to add on to.

We want a flexible floor layout.

And we want to keep the cost low.

Now, what structural material do you recommend?

How to give the community what it wants: Recommend framing the school building with structural steel. Only steel framing meets all these demands. Both steel producers and steel fabricators have expanded facilities. There's an ample supply of the fabricated structural shapes you need — when you need them.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

. . . . . Am-Soc Briefs

▶ ▶ Congratulations and thanks to the Cleveland Section for a job well done. . . . Members returning from the Cleveland Convention are talking about ubiquitous G. Brooks Earnest who, as head of the Reception Committee, saw to it that all received an enthusiastic welcome; the Friday trip to the Lewis Research Center, with its fantastic wind tunnels for testing jet aircraft engines; the behind-the-fence party (dinner at the stadium followed by an Indians vs. Orioles ball game); the impressive new Cleveland Engineering and Scientific Center; and the foretaste of summer weather.

▶ ▶ The Board of Direction, in session during the Convention, nominated Frank Marston, Boston consultant and former Vice President and Director of ASCE, for next year's President; selected five new Honorary Members; endorsed the Prize Committee choices for the Society's coveted annual awards; extended to October 1 the deadline for Local Section suggestions for changes in District and Zone boundaries; and approved a plan for annual selection of "the outstanding civil engineering achievement," with the idea of increasing interest in the work of civil engineers.

▶ ▶ Of interest, also, was the Board's authorization of a cooperative committee with the American Institute of Planners, to be called the ASCE-AIP Joint Cooperative Committee.

▶ ▶ The ASCE-AGC Joint Cooperative Committee has been functioning for a number of years to the mutual benefit of both groups. . . . A recent result of this cooperation is the new recommended guide to bidding procedure, prepared jointly by ASCE and AGC. The guide is described and directions for ordering are given in the Society News section.

▶ ▶ On June 6 the new ASCE membership designations go into effect — a month after presentation of the results of the ballot to the Society's business meeting in Cleveland. Those who are now Member, Associate Member, or Junior Member will automatically become Fellow, Member, or Associate Member. The details of the change-over are summarized in Society News.

▶ ▶ Engineers Information Service. . . . As a possible further service to readers, we are testing a new method of obtaining additional information on advertised products and new developments reported in "Equipment, Materials, and Methods" and "Literature Available." The proposed Service is explained on page 141.

▶ ▶ Doing something about the weather is the theme of the Weather Modification Conference set for August 27-29, at the Albany Hotel, Denver. The sponsors are ASCE's Irrigation and Drainage Division and the American Meteorological Society. Four half-day sessions are planned, with the emphasis on artificial means of provoking weather conditions. The program will be in the July issue.

60-foot long Blaw-Knox tunnel form in position inside east diversion tunnel at Glen Canyon Dam. Each linear foot of the 33-inch tunnel wall required 20 cubic yards of concrete. Blaw-Knox Forms consistently met accuracy requirements.

Blaw-Knox Steel Forms ease concreting of Glen Canyon Dam Tunnels

Two 60-foot long, 41-foot diameter, non-telescopic tunnel forms met required standards of accuracy in the concreting of 6,000 feet of diversion and spillway tunnels at Glen Canyon Dam on the Colorado River. Their special design permitted the lining of curved or tangent sections within radii as small as 165 feet.

A total of 140,000 cubic yards of concrete was used in constructing 33-inch thick tunnel walls. Preassembled outside the tunnel, the Blaw-Knox Forms were mounted on rails. After the form was placed, a series of hydraulic jacks expanded the unit to match the "A" line grade. Concrete was pumped into place, vibrated to eliminate honeycombing, and cured for 16 to 24 hours.

Merritt-Chapman & Scott Corporation, prime contractor for Glen Canyon Dam, employed a 20-man crew to set, strip, and reset the form. A specially designed Blaw-Knox screed was used to pave inverts of both tunnels. This method, combined with the accuracy of the Blaw-Knox Forms, pour after pour, helped to considerably reduce time and costs.

Blaw-Knox Steel Forms Consultation Service is available to contractors on all types of concreting. For more than forty years, Blaw-Knox Forms Engineers have made their experience available to enable contractors to save time and cut costs on dams, bridges, and tunnels. Contact us early in your planning for a profitable engineering contribution, or you may wish to write for a copy of technical report 2571 covering this project.

BLAW-KNOX

BLAW-KNOX COMPANY

Blaw-Knox Equipment Division
Pittsburgh 38, Pennsylvania *STerling 1-2700*

do you know that

The St. Lawrence Seaway will be dedicated this June? The 2,600-mile waterway, called "the project of the century," will be officially opened by President Eisenhower and Queen Elizabeth at Montreal ceremonies on June 26. Actually both ocean-going vessels and river traffic have been operating since the break-up of river ice late in April, and most of the time there are impressive flotillas of ocean liners, freighters, and small craft waiting their turn to go through the locks. The joint U.S.-Canada project was built in five years at a cost of well over $500,000,000. Though over 10,000 men were employed at the construction peak, the project set new standards for construction safety.

▪ ▪ ▪

An important land route is being pushed in Canada? After eight years under construction, the 4,470-mile Trans-Canada Highway is scheduled for completion by December 1960. Running through five of Canada's national parks, the coast-to-coast (Newfoundland to British Columbia) route will be one of the most scenic in the world. The western part of the road has become well known for construction difficulties in mountainous snowslide areas.

▪ ▪ ▪

Venice is slowly sinking into the sea? According to engineers, the City of Canals is doomed despite a fifty-year remedial program aimed at shoring up weakened buildings, among them St. Mark's. The melting of the polar ice caps, which has raised the sea level, and the sinking of the earth at the mouth of the Po River have caused Venice to drop 5 ft in its 1,500-year history. The present rate of sinking is 8½ in. a century.

▪ ▪ ▪

It is not the old cars that cause the most accidents? In South Carolina last year the newer automobiles were involved in more wrecks than the older vehicles. State Highway Department records reveal that 9,802 vehicles one year old or less were wrecked and 6,771 vehicles one-to-two years old were also wrecked. A total of 251 died in the crashes of these new and relatively new vehicles.

▪ ▪ ▪

The U.S. is going to bore into the earth's crust? This spring four U.S. research ships are assembling north of Puerto Rico to begin looking for the most suitable spot for drilling a hole through the earth's crust. The project, said to be one of the most dramatic scientific endeavors of the generation, is aimed at finding out what the bulk of the world is really made of. It involves drilling holes several miles deep in the ocean floor beneath several miles of water. Over-all planning of the project is under the National Academy of Sciences, with the Lamont Geological Observatory the coordinating agency.

▪ ▪ ▪

The nation's level of education is steadily rising? The trend toward more schooling has been especially marked since the outbreak of World War II. In 1957 more than two-fifths of the population at ages 25 and over had at least a secondary school education, compared with only one-fourth in 1940. If the trend continues, as is expected, more than half the adult population of 1975 will have had at least a high school education, and almost one-tenth will have received a college degree. About one-seventh of the white male population will have completed college. For these data we are indebted to a recent issue of "News and Cues" of the Chamber of Commerce of the United States.

▪ ▪ ▪

There are more than 14,000 accidental work deaths a year? In 1937, with a much smaller work force, the death toll was 19,000. Despite the change for the better, one person dies accidentally on the job every 37 minutes, according to the National Safety Council. A work injury is suffered every 16 seconds. Falls are a prime cause of both fatalities and casualties.

▪ ▪ ▪

The Army has developed a special shelter for use with its Jupiter Missile? The weatherproof shelter—designed by the Engineer Research and Development Laboratories at Fort Belvoir—covers the lower part of the rocket, creating a watertight seal that protects instruments and equipment until the rocket is ready to be fired. It consists of twelve 30-ft aluminum panels, radiating around the missile like the petals of a flower. When adjustments on the missile are completed, synchronized motors raise the panels and close them around the rocket. When the missile is ready for firing, electronic equipment takes over, causing the panels to open up and return to the ground. The interior of the shelter is coated with a paint capable of resisting temperatures of over 1,000 deg F.

▪ ▪ ▪

This is the diamond anniversary of the AIEE? Congratulations to a sister society, which is marking its seventy-fifth anniversary with a Diamond Jubilee Year. When the AIEE was founded in May 1884, its roster listed seventy-one members, among them such notables as Thomas Edison and Alexander Graham Bell. Today it is a world-wide organization with a membership of over 52,000. The organization meetings were held in the ASCE headquarters in New York, then on 23rd Street.

a progress report—

Glen Canyon Dam Project to open vast new area

Work on huge Upper Colorado River Project well under way

When completed some six years hence, the giant Glen Canyon Dam, Reservoir and Powerplant Project will unlock the riches of a vast, 10,000-square-mile area.

The high concrete gravity arch dam, rising 700 feet from bed-rock, will contain 5,493,000 cubic yards of concrete. Power from the 900,000 KW power plant, located 470′ downstream from the dam, will make possible the development of huge resources of fuel, oil, minerals—including uranium—and timber.

When filled to capacity the 28,000,000-acre-foot reservoir will stretch 186 miles up the Colorado and 71 miles up the San Juan, a major tributary of the Colorado. Basically, this project is for river control and power generation.

Largest single dam contract on record

The $107,155,222 contract for the Glen Canyon Dam and Powerplant, largest ever awarded by the U.S. Bureau of Reclamation, went to Merritt-Chapman & Scott Corporation, New York. On April 29, 1957, the day the contract was awarded, Merritt-Chapman & Scott signed a contract with Fairchild for aerial mapping of the dam site, reservoir and areas adjacent to the dam site. Flying operations began on May 5, *just six days later!* Advance copies of flying results were delivered on May 26. Other detailed data followed soon after.

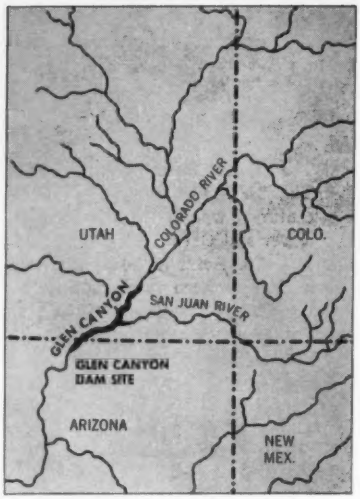
Scale of maps for Glen Canyon

Reservoir: 1″ equals 400′, 10′ contours

Dam site: 1″ equals 50′, 2′ contours

Areas adjacent to dam site: 1″ equals 200′, 5′ contours

During the past 34 years, Fairchild crews have flown similar mapping assignments all over the free world. Results produced from this experience have led thousands of Fairchild clients to say . . . if you want it done *fast* and *right the first time*, you can depend on Fairchild.



Site of the 700′ Glen Canyon Dam, second in height only to Hoover Dam (726′) is located 12 miles downstream from the Arizona-Utah border—370 miles upstream from Hoover Dam.

Walls of the canyon at the dam site are 650′ high with overhang in places. This necessitated flight paths parallel to the walls but offset to see under the overhangs.

FAIRCHILD AERIAL SURVEYS, INC.

Los Angeles, California: 224 East Eleventh Street • **New York, New York:** 9 Rockefeller Plaza • **Chicago, Illinois:** 111 West Washington • **Boston, Massachusetts:** New England Survey Service, 255 Atlantic Avenue • **Houston, Texas:** 3325 Las Palmas • **Birmingham, Alabama:** 2229 First Ave. North

CIVIL
ENGINEERING

Current challenges in civil engineering

From the President's Annual Address at the Cleveland Convention

FRANCIS S. FRIEL, President ASCE

Albright & Friel, Inc., Philadelphia, Pa.

Perhaps the most important new activity of the American Society of Civil Engineers this year has been fund raising for the United Engineering Center. If there is any one activity that characterizes our American way of life it is fund raising. From the cradle to the grave, whatever our walk of life, we are almost continuously involved in the process of collecting, distributing, or less often receiving, money in the name of some worthy cause.

What does a discussion of fund raising as a national characteristic have to do with the Annual Report of the President of ASCE? As I reviewed the year's work, it struck me that the outstanding activity of the year had been the campaign to raise money for the Engineering Center. It seemed to me that the most useful thing I could do at this meeting would be to discuss with you the lessons I have learned from this fund raising effort.

When a group of people get together voluntarily and on a volunteer basis to raise money for some deserving institution or organization, several purposes are served. First, of course, the money is collected. Second, and often equally important, an educational process takes place. Finally, valuable leadership is discovered and developed. Lacking this means of obtaining the services and structures we feel are needed in our communities, we might be forced to resort to socialism or communism, or some other alien form of government to take care of the needs of the people. We believe that our system of free enterprise is the most efficient possible, and that it provides us with a high standard of living. It also (and we must not forget this corollary) obligates us to help one another according to our needs and our ability. It both enables us and challenges us to help ourselves.

Campaign for Engineering Center

When the engineers of America realized that there was a need for a new Engineering Center, we knew what to do. We were not dependent on any mysterious or unapproachable Higher Authorities. We did not need to wait for the lengthy and deliberate mechanics of bureaucracy. We had the power, the means, and the ability to help ourselves.

According to our time-honored American custom, we simulated military command for our campaign, enlisting generals, captains, lieutenants and so on down to privates. (With the ASCE organization of Zones, Districts, and Local Sections it was easy to chart this chain of command.) As in the army, the generals planned the strategy and gave the orders. The enlisted men were sent out on the firing line to do the "hand-to-hand" fighting—that is, to put out their hands and keep them out until money was put into them.

The enlisted men ran certain risks and some were certainly victims of battle fatigue. A few are now entitled to slow-up, for certain Sections have reached or even exceeded their quotas. It is interesting to note that those Sections that have tasted success are still among the most active in the campaign.

Once the goals and quotas were set

and the workers drafted, it was obligatory to have a kick-off dinner. This amounted to a formal declaration of war. We had a very big gun indeed—Herbert Hoover—to initiate the attack. We were honored that the most distinguished living American engineer was there to state our case so clearly and so forcefully.

Most of you know the statistics of the campaign. Industry was asked to contribute five million dollars. This is 86 percent pledged. Member giving, in which each member is to contribute a share, was set at three million dollars for the five Founder Societies. All member giving has reached 75 percent of its goal. Quotas were equitably apportioned among the participating engineering organizations; that for ASCE is $800,000. So far we have raised nearly a half million dollars.

Of course, excuses can be made to explain the fact that ASCE is not out in front. Perhaps the main one, from my observation, is that many have not been contacted and given an opportunity to contribute. Only about 19 percent of our membership has contributed so far.

Campaigns call for stock-taking

To supply ourselves with ammunition for the campaign it was necessary to consider the needs we are trying to meet. So we began to analyze the purposes of our Society, to take stock, in order to see in what respects we have measured up to our stated purposes, and in what respects we have failed. This, to me, is one of the most valuable by-products of any campaign.

Standards of practice

One of the primary reasons for the founding of our Society was to establish a code of ethics, to set standards for conditions of practice. A campaign that forces us to justify our activities reminds us of the value of this function.

Yet, at this time of stock-taking, it might be well to ask ourselves if the emphasis in ethical matters has not been too much on the negative, and too little on the positive side. With more than 42,000 members, instances of punitive action for violations of our Code are rare. Our Committee on Conditions of Practice sees to it that standards are reasonable in the light of the times; that they are up to date; that they are realistic; and that they take care of current problems. This is fine. But is it enough?

Are we guilty, as Mark Twain put it, of being "good men in the worst sense of the word"? Are we content simply to do no wrong? Do we sometimes fail, for instance, to protest against unnecessary construction? More important, do we fail to take the initiative, where we are highly qualified, in suggesting for example, good city and regional planning, adequate flood control, effective programs of resource conservation? Are we willing to take part in the hard work of civic committees to promote our plans? In this sense are we really living up to the highest standards of engineering practice?

Development of young engineers

A vital part of the ASCE program has always been the development of young engineers. The Society has sought to help young engineering graduates to continue their education and develop fully as engineers. But have we made an intelligent effort to develop potential leadership for our Society among our younger members?

If the campaign revealed some weaknesses in our leadership, and a failure to encourage younger members to assume responsibility, it also provided the means for correcting the fault. Fund raising is an excellent means of developing leadership and discovering leadership potential. In the campaign work young members will learn all about their Society, will gain more from their membership, and will advance rapidly in the organizational hierarchy. ASCE as a whole will benefit immeasurably from this development of its younger members.

The campaign has pointed up the fact that we need better facilities at Headquarters for our publications, meetings and conferences, which are, of course, the core of the ASCE program. This fund raising, successfully completed, will enable us to do a much more effective job than has been possible up to now. The equipment and space available in the new Engineering Center will make a tremendous difference in our activities.

Research

The new center should make it possible for us to do more research. Our campaign-inspired analysis would seem to me to reveal that we are not making our full and proper contribution to the advancement of knowledge. We can try to correct this weakness in several ways: first, by providing greater incentive to research, as we have already begun to do; second, by providing improved facilities for research; third, by urging more emphasis on the sciences in engineering education; fourth, by supporting those institutions of higher learning in which such research should be conducted; and fifth, by making provision in industry, and indeed in our own firms, for research work.

It is time for us as members of the ASCE to consider our responsibilities in relation to recent developments in science and research. The great new discoveries, the astonishing progress in science of the last decade, have imposed on all men, everywhere, relentless demands.

We need more knowledge than we used to have, and more courage, more wisdom, better judgment, and more imagination. Mankind's most urgent need right now is not bigger and better laboratories where faster and more powerful rockets can be built, but laboratories conducting research to discover how men are to live in an environment which has suddenly expanded to include not one planet but many. By deliberating and acting together we can maintain the balance we need if mankind is to survive in his new environment, if mankind is to survive as man.

This year, for the first time, we established a fellowship grant in civil engineering research, to be made from current Society income, in the amount of $5,000 annually. Still we must acknowledge that at two points our performance in research is inadequate. We are not doing enough basic research and we are not utilizing sufficiently the knowledge we have.

Strength and weakness of ASCE

Specifically, what has this intensive campaign shown us about the structure of the ASCE, its strengths and weaknesses? We have learned conclusively the rather obvious fact that the Society is only as strong as the leadership of its Local Sections. The problems of the Local Sections mirror the larger problems of the Society—and two of those problems are unity and communications.

We can function more effectively as a group if we work in unity with the other engineering societies. The campaign has emphasized the need for working together, and has shown us how easy it is. Task forces from the various Founder Society organizations have worked well together. The fact is that we have already achieved a greater degree of unity than most members realize. Perhaps the time has come to accentuate the positive. I am of the firm belief that unity will shortly be achieved.

The campaign has also disclosed the fact that it is easy to lose focus in trying to transmit the ideas and enthusiasm of Society officers and committees to the members of Local Sections. We need to help local groups achieve a stronger sense of relationship with the national structure—and vice versa. Much has been done to accomplish just this. Yet more needs to be done to give the individual engineer a sense of professional identification and pride not

only with this local unit but with all that goes on nationally. This is a two-way street.

The problem of adequate communications includes not only the internal exchange of ideas, but the external expression of our beliefs and achievements. All these external communications add up to a public relations program. A sound public relations program is vital for us as a society and as individual engineers.

For one thing we should take proper credit for the work of some of our Society Members. There is a tendency to stress technical and private issues rather than public ones when the Society speaks to the general public. Not only is the Society not understood; it is not saying what the public is interested in hearing.

Results of campaign

I believe that this fund raising campaign has helped us to develop the kind of leadership that is being demanded of us. I believe that the fund raising experience has helped us to set our sights high, to think big. Conclusively, the campaign has demonstrated a fact that has been suspected for a long time—that the Society is as healthy as the sum total of its working members in Local Sections.

Dues can buy services. They can buy an administrative staff to implement the orders of the officers and the Board of Direction. But when offered passively, like a tax dutifully paid, dues alone cannot buy lasting achievement. The organization that is supported only by passive members who pay dues in exchange for services is headed for oblivion. The health and vigor of a professional Society—like the health and vigor of a professional man—are measured directly by the things it does for itself, through volunteer, individual, and enthusiastic effort.

Our drive to raise money for our Engineering Center has helped us examine our strengths and weaknesses as a Society. It has given us an opportunity to work with the other Founder Societies demonstrating a degree of unity that is most gratifying. It has developed leadership within our own ranks. It has measurably improved our public relations. Finally and most important, it has focused our attention on the part we should play as citizens.

So as we continue our campaign for the Engineering Center, we may be battle-scarred and weary, but we are, I am convinced, a stronger organization and better men because we are trying to raise money for a good cause. I salute you as seasoned campaigners, who will soon, I trust, be victorious veterans.

Neville House, a modern apartment building in Pittsburgh, has a structural system of reinforced concrete with brick and glass exterior walls above the first floor. Ground floor, which is open, serves as a colonnade leading to the centrally located elevator shaft. Tasso Katselas is the architect.

Concrete arches support a Pittsburgh apartment building

R. M. GENSERT, F. ASCE, Gensert, Williams & Associates, Cleveland, Ohio

EMIL C. HACH, A.M. ASCE, Engineer, Gensert, Williams & Associates

Concrete arches, at the ground-floor level, are supporting a Pittsburgh apartment building designed for luxury living. Additional support for the building comes from concrete walls at elevator and stair towers located in the central part of the building.

The Neville Street Apartment Building, at Neville Street and Fifth Avenue in Pittsburgh, Pa., consists of eleven stories including basement. The underground garage and basement encompass an area of 90 ft x 219 ft while a typical floor is 45 ft by 201 ft 6 in. The entire structural system is of reinforced concrete. Exterior walls above the first floor are of brick and glass, but the ground floor is open, and serves as a colonnade leading to the centrally located elevator shaft.

In the appearance of this building, the structural form was subordinated to the clever manipulation of shape and color, yet the structural frame promotes function and use.

The plan of a typical floor appears in Fig. 1. The floors are 9-in. flat slabs with continuous cantilevers extending 6 ft 4 in. from the face of the column along each side. At the front of the building the 12-in.-thick slabs are cantilevered out 12 ft 3 in. from the face of the column. The entire analysis was based on continuous-frame analogy. Because of this direct analytical approach, it was possible to evaluate stresses with accuracy, and thus to determine the proper amount of moment reduction that results from the 7-ft-wide columns in the transverse direction.

In Fig. 1, note the floor opening at the rear stair tower. This opening necessitated the use of cantilevered strips and additional supporting-slab strips which caused a considerable departure from typical slab reinforcing. The first floor, which is supported directly on the arches, behaves very much like a flat slab in the short or transverse direction of the building. In the longitudinal direction its action is more like that of a one-way continuous slab, which results from the line support of the arches, rather than from the concentrated support of a typical column. Supporting columns are 12 in. x 84 in. for the full height of the building and they, in turn, are supported on the sculptured concrete arches at the ground-floor level.

As is often done for structures of this type, a model analysis was made with the hope of confirming an intuitive estimate of the flow of stresses and their resulting strains. The two-column bents with supporting arches presented a problem, as it was difficult to evaluate their structural behavior. Since the columns are 100 times stiffer than the slabs, it was obvious that they do not constitute a typical portal with inflection points at the mid-heights of the columns. It appeared that the columns might be acting as cantilevers supported on a rigid compression arch or shear wall, the slabs acting to merely transmit wind thrusts from the windward to the leeward column. On the other hand, the support for the columns might be a rigid frame with several possibilities as to the location of hinges. These various possibilities are shown diagrammatically in Fig. 2.

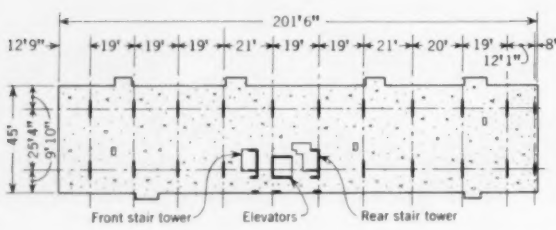


FIG. 1. Typical floor plan has area of 45 ft by 201 ft 6 in. Floors in the modern apartment building are 9-in. flat slabs with 6-ft 4-in. continuous cantilevers, from face of column, along each side.

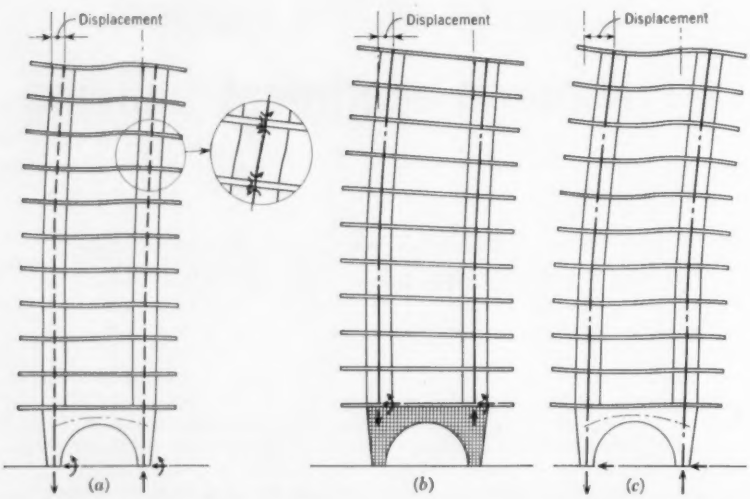


FIG. 2. The two-column bents with supporting arches presented a problem in making a reasonable evaluation of their mode of structural behavior. Methods of design tried were: (a) portal method, in which moment of inertia of columns and slabs should be nearly equal; (b) cantilevered columns supported on rigid compression arch or shear wall; (c) cantilevered columns supported on a two-hinged or rigid frame.

Estimated moments

Any intuitive approach to an engineering analysis must of necessity be based on a conservative interpretation of the structure's behavior. This does not mean, however, that an unreasonable factor of safety should be used. For the supporting bents of this apartment building, moments were proportioned to the arch by assuming a hinge at the base of each arch leg, and a wind moment plus wind shear acting at the top of each arch in conjunction with the uniform load from the first floor. The concept of a hinge at the base of an arch gives a condition of maximum moment at the haunch. Reinforcing the base of the arch with maximum steel (8 percent) will reduce the moments at the haunch by the equivalent amount of moment that can be absorbed at the base.

The slabs were considered as struts between the freely cantilevered columns. Nevertheless, the slabs were checked for a moment that was based on wind shears at mid-span much as in the case of a simple portal. A visual reevaluation of the arch for a possible shear failure indicated that the weakest section would occur at the crown. By considering a hinge at the crown, the structure was made statically determinate, and the corresponding shear stress was computed. The arch is shown in Fig. 3.

Model analysis

It was decided to investigate the building frame by a model analysis that would be visual as much as possi-

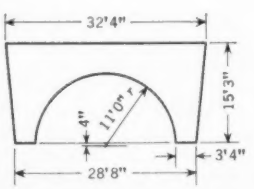


FIG. 3. Each concrete arch at ground-floor level supports two-column bent for full height of building.

ble and yet would be accurate enough for analytical purposes. One of the best techniques is the Begg's deformeter method. This method requires a model of the building frame cut from an elastic material. All sections of the model are given sizes and shapes to match the relative moment of inertia of the sculptured, three-dimensional prototype. Precision gages are affixed to the model at predetermined points where known thrusts, shears and moments are introduced into the model. The displacements of load points on the model are measured with micrometer microscopes. The results of these readings give influence diagrams that determine the values for shear, thrust and moment at various points on the model due to external loads of any magnitude.

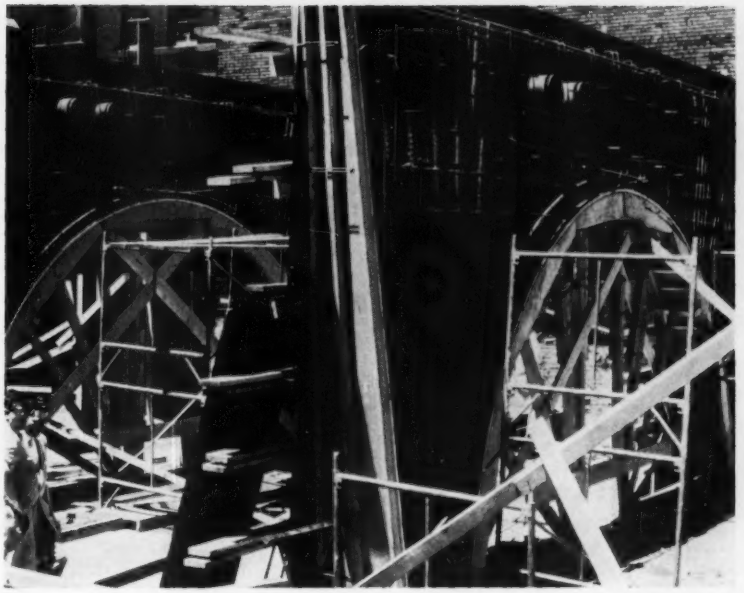
Table I gives a comparison of values for shear, thrust and moment under two design assumptions and the model analysis. The greatest deviation for moment was at points A and B as expected. These deviations were on the side of safety and did not affect the column or slab design. The column moments were reduced by the combined action of the columns and slabs acting together much like a Vierendeel truss. The final arch stresses showed little change from the preliminary design.

This investigation accomplished two things of general engineering interest. First, it confirmed the feasibility of a conjectured design, and second, it showed that the typical portal analysis, which is often resorted to, would not have been a correct solution for this particular building frame.

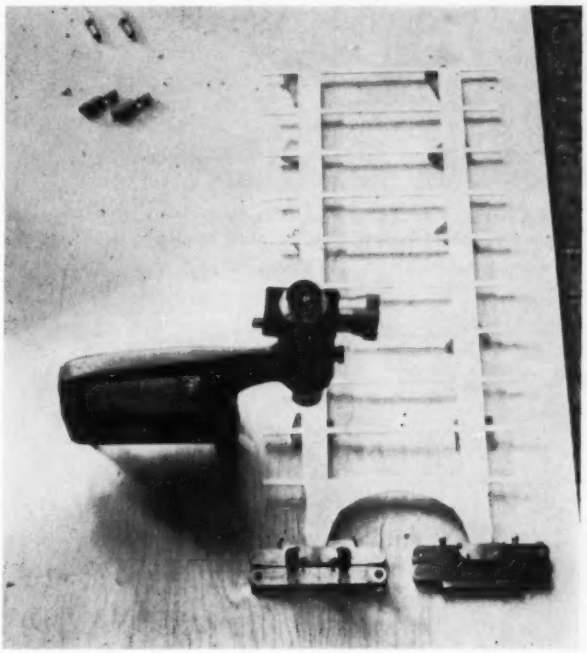
Structural engineers for the building were Gensert, Williams & Associates, Cleveland, Ohio. The architect was Tasso Katselas, Pittsburgh, Pa. The contractor was Gratziano Construction Company, Pittsburgh, Pa.

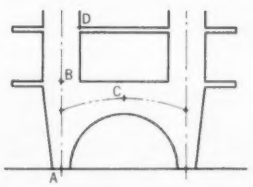
TABLE I. Preliminary and final designs compared with typical portal design

Location in Sketch	Preliminary Design	Model Analysis	Portal Analysis
Moment, ft-kips:			
A	341	205	124
B	673	396	71
C	369	4	0
D	77.5	28	133
Shear, kips:			
A	17.7	18.1	17.7
B	14.2	23.1	14.2
C	72.8	33.8	15.4
D	10.5	3.1	10.5
Thrust, kips:			
A	72.8	61.6	64.1
B	49.0	27.8	48.7
C	1.8	5.0	1.8
D	1.8	1.4	1.8

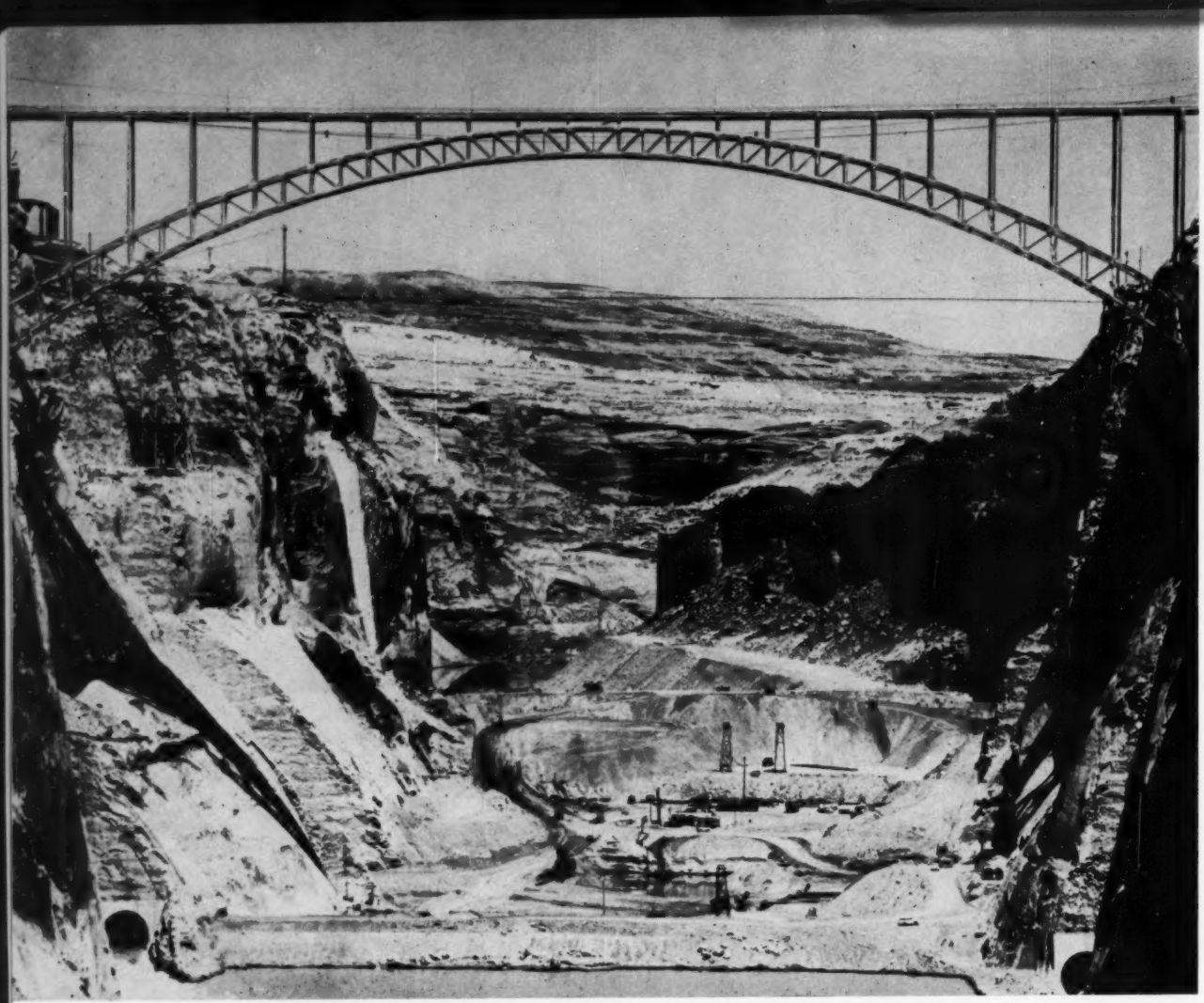


Forms and reinforcing for arches are being assembled. Concrete was placed by crane and bucket. Arches were cast in place and finished by sand blasting.





Begg's deformeter method of model analysis was used to investigate the building frame. Precision gages were affixed to a model of it, and from measurements of load-point displacements, influence lines were determined.



Glen Canyon Dam site as seen from downstream. The Colorado River is being diverted through tunnels at each side. Note start of concrete plant construction on shelf at upper left. Facilities and equipment valued at $10,000,000 are required to do the job.

Glen Canyon Dam--

Ten-million-dollar construction plant

JOSEPH PERAINO, F. ASCE

Chief Engineer, Construction Department,

Merritt-Chapman & Scott Corporation,

New York, N. Y.

When Merritt-Chapman & Scott was awarded the contract for construction of the Glen Canyon Dam, powerhouse and appurtenances on a low bid of $107,955,522, it represented the largest contract ever let by the Bureau of Reclamation. It also represented the biggest competitive contract ever awarded to a single contractor. One month after the award was made, on April 29, 1957, work was under way at the dam site on what was to be one of the largest construction plants ever assembled.

The story of Glen Canyon's construction plant matches the U. S. Bureau of Reclamation's project itself as a story of king-size proportions. (See article by W. A. Dexheimer, F. ASCE, CIVIL ENGINEERING, July 1957, vol. p. 473.) The dam will be the second highest in the United States and will rank third in concrete volume. To do the job with maximum efficiency within the stipulated 2,500-day period, the contractor had to mobilize facilities and equipment valued at $10,000,000. Many

items in this array of specially designed plant can best be described as "biggest," "fastest" or "first ever used."

Any attempt to describe this plant necessarily becomes a story of Merritt's over-all plan of attack on the Glen Canyon Project. Design engineers, when starting a project, first visualize all the requirements of the structure that is to be built. Construction engineers follow much the same procedure. First they make a plan of attack, then design and assemble a plant layout to meet the requirements of their schedule. Merritt started work on this gigantic project with a low bid, a nucleus of key personnel and the usual specifications—in this case, two bulky books totaling 404 pages and 209 drawings.

Back of that successful bid stretched weeks of carefully detailed project planning, which had started the day the specifications arrived. It included the preliminary design of special equipment —some never before used in dam construction—and a long-range plan to insure the steady flow of material and manpower to this isolated and parched area in north-central Arizona.

Seldom has a contractor faced such a combination of geographical problems. The closest town to the dam site —Kanab, Utah—was 75 miles to the west and the closest railhead—Flagstaff, Ariz.—was 135 miles to the south. Until an adequate project base could be built on the canyon rim, the first field headquarters were set up at Kanab. From there the only vehicular access to the site was a narrow, unimproved road.

Of all the geographical headaches, the most severe stemmed from the fact that Glen Canyon is an impassable gorge 1,200 ft wide and 700 ft deep. Vehicular and foot traffic had to travel some 200 miles by a roundabout route to get from one side to the other.

When Merritt's first work force arrived at the site just 20 days after the notice to proceed was received, its plan of attack already was in motion. The contractor knew what would be required in equipment and plant as well as material and manpower, and the logistics had been worked out.

Surveyors began to lay out the contractor's permanent camp. Trucks and earth-moving equipment moved in to carve roads and clear areas for offices, shops, warehouses and trailer housing facilities. A diesel-powered generator, the first in a power plant that eventually would include 14 units, was set up to furnish light and power.

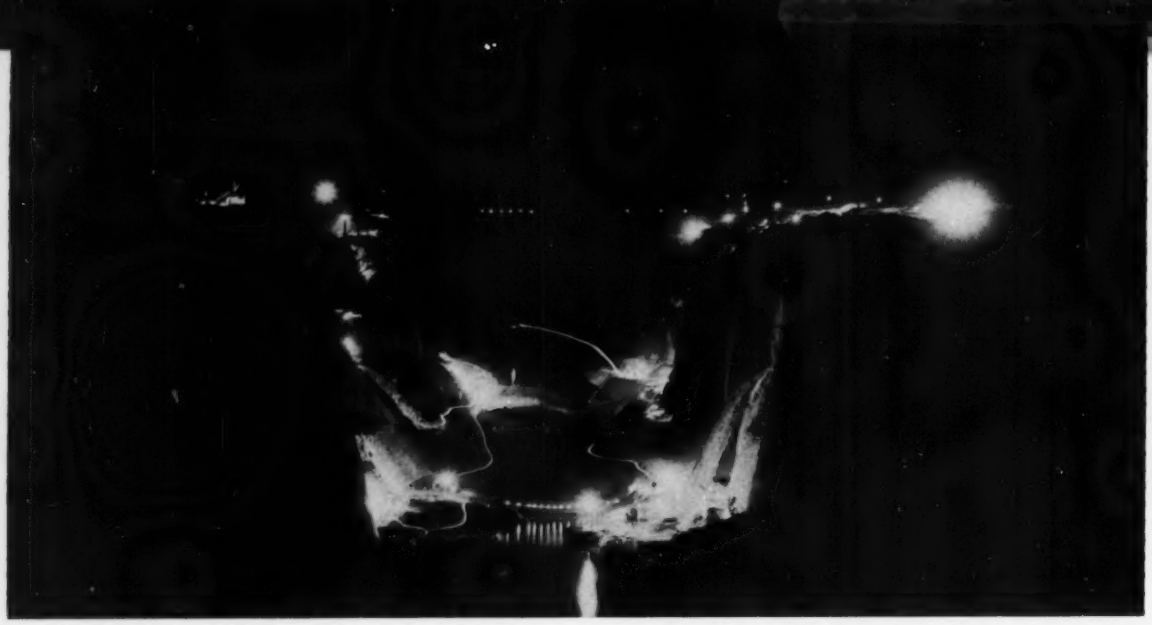
Meanwhile, in Kanab and in the contractor's New York office, crews of engineers added the final touches to the design of the construction plant. With more than 5,000,000 cu yd of concrete to be placed in the dam and powerhouse, the project plan called for a 38-month concreting schedule with an average placement of 9,600 cu yd per day. To achieve this output, several alternative methods were weighed. Finally it was decided to use specially designed 12-cu yd buckets. No bucket with a capacity greater than 8 cu yd had ever been used on a dam before.

Use of the 12-cu yd buckets required installation of two giant traveling cableways each of 50-ton capacity—the largest and fastest of their type. King-size concrete transfer cars will move 24 cu yd at one time to a cableway transfer point. This equipment had to be backed up with facilities for mixing, cooling and conveying up to 200,000 cu yd of concrete in a maximum production month. The aggregate plant had to be capable of feeding the biggest batching plant ever employed for dam construction. The cableways, concrete transfer cars and placement buckets are geared to speeds that make it possible to load, transfer and place 48 cu yd of concrete every 5½ minutes from two cableways. A smaller cableway serves the powerhouse. Cooling is provided by the largest industrial refrigeration plant on record.

When the prime contract for the dam and powerhouse was awarded, work already was under way on the highway bridge that now links the two sides of the canyon. (See "Building the World's Highest Arch Span," by Francis T. Murphy, F. ASCE, CIVIL ENGINEERING, Feb. 1959, vol. p. 86.) Work was also under way on two diversion tunnels of 41-ft diameter that will divert the Colorado during construction. Included in the tunnel contractor's construction plant was a cableway that stretched across the gorge and a "monkey slide" (an inclined elevator, on a cable track) which gave access to the canyon floor. Merritt arranged with the tunnel contractor to share this equipment. Except for the cableway, the only way to reach the opposite rim was by plane or by back-tracking to Kanab

Concrete plant with six 4-cu yd mixers is erected below the cooling installation. Note inclined personnel elevator at right.

Cableways have capacity of 50 tons to handle 12-cu yd buckets of concrete on spans of 1,800 and 2,050 ft.



Work goes on around the clock at Glen Canyon. The Colorado River was forced into diversion tunnels by closing off the channel with earth and rock.

and crossing the river south of the dam site at the Navajo Bridge, a circuitous trip of nearly 200 miles.

By September 1957, four months after the award of the contract, Merritt's field staff was able to move to the dam site. With no way to cross the gorge except by plane or high-line, most of the contractor's permanent camp facilities were erected on the west side. These facilities included air-conditioned offices, maintenance shops, oil and grease houses, warehouses and a powerhouse. On the wall of the canyon, two monkey slides were constructed, and a 25-ton cableway was stretched across. Work was begun on the pilot aggregate plant and the temporary batch plant.

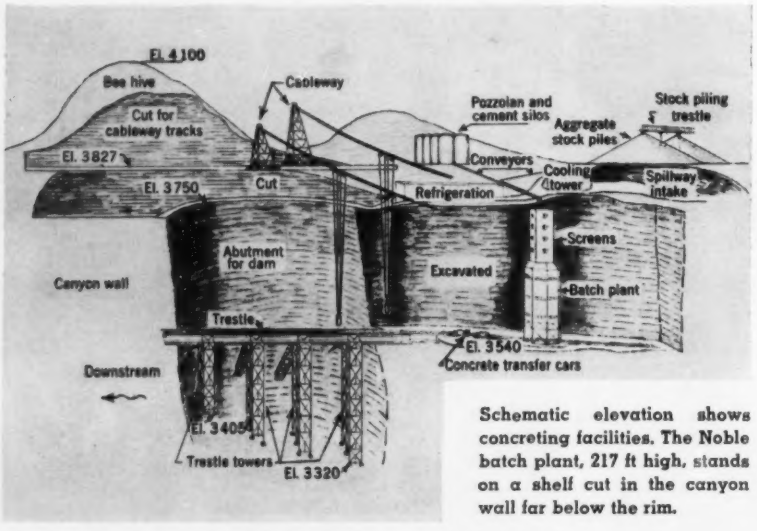
To provide direct access for personnel from one side to the other, the canyon was spanned by a footbridge 7 ft wide, suspended from towers 100 ft high. Anyone walking across could look down through the steel-mesh deck to the Colorado River 700 ft below. After the footbridge was completed, in November 1957, most of the contractor's rapidly growing work force and their families were concentrated on the east side, where the Bureau of Reclamation has developed the new town of Page, on a mesa two miles from the dam site.

Two narrow footbridges, of cable and timber, were strung across the canyon at river level to give workmen quick access to both banks. One was placed near the upstream portals of the diversion tunnels, the other about 1,900 ft downstream. However, the suspension footbridge at the rim of the gorge remained the main gateway to Page.

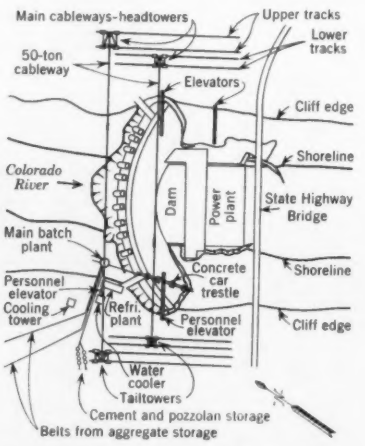
With a present population of about 5000, Page is truly a city that sprang up almost overnight. In addition to more than 800 trailers moved in by the contractor, several dormitories were erected for single employees and nine residences for key personnel. Marketing and service facilities, various stores, a post office, a gas station, a bank, and a 25-bed hospital also were constructed by the contractor. Additional homes and offices and some dormitories were built by the Bureau of Reclamation.

The Glen Canyon Project called for the driving of about 18,000 ft of tunnels —two diversion tunnels, two spillway tunnels, a powerhouse access tunnel and a control cable tunnel. While the dam is being built, the 41-ft-diameter diversion tunnels will be used to divert the river. When the dam is completed, the downstream part of these tunnels will become part of the spillways.

At first the Colorado was diverted through the right diversion tunnel since this was virtually at river elevation, whereas the portal of the left tunnel



Schematic elevation shows concreting facilities. The Noble batch plant, 217 ft high, stands on a shelf cut in the canyon wall far below the rim.



Major units of the $10,000,000 construction plant are shown in relation to the permanent structure.

was 35 ft higher. By the time the river flow exceeds the capacity of the first diversion tunnel—in May or June—preparations will have been completed to start it through the second diversion tunnel.

Aggregates

The only source of acceptable aggregate, within economic hauling distance of the dam site, was found on Wahweap Creek, a Colorado River tributary five miles north of the dam site. This aggregate has a considerable proportion of material with a specific gravity not acceptable for use in face concrete or tunnel lining. Specifications for Glen Canyon require that heavy-media aggregate be used for exposed concrete—some 600,000 cu yd, or about 12 percent of all concrete in the dam. To prepare this heavy-media aggregate, particles with a specific gravity of less than 2.5 must be removed from aggregate sizes No. 8 through the 1½ in. Such separation, not previously specified on dam construction in the United States, requires a special process, for which a pilot plant has been constructed at the Wahweap aggregate source.

At this plant the aggregate is passed through a heavy fluid, of 2.5 specific gravity, utilizing an inclined rotating screw and an air-lift process. Heavier rock passes through the fluid but the lighter particles float and can be collected and wasted. A fluid of the right specific gravity is secured by mixing finely ground ferrosilicon and magnetite with water in proper proportions.

Aggregate is mined from the river bed by a 6-cu yd dragline and loaded onto a 30-in. conveyor belt through a combination grizzly and feeder. The gravel deposit varies in depth from 15 to 25 ft.

The initial function of the pilot plant was to produce heavy-media beneficiated aggregates to line the tunnels and to accommodate the contractor's plant requirements. Currently all aggregate is processed. When major concreting gets under way only a small percentage will require heavy-media aggregate, that on exposed faces of the dam and powerhouse.

From an input of 2,500 cu yd per day, the plant produces 900 cu yd, separated into three sizes. The sand is separated on an 8-mesh screen, and all smaller material is passed through a dewatering and classifying tank.

An attempt to beneficiate the sand and gravel as a composite material failed since the float product carried off a large percentage of the sink product and the sink product did not consistently meet specifications. After many tests a second unit was built to treat the material passing the 4-mesh screen and retained on the 8-mesh, as a separate operation. The initial plant could satisfactorily treat the coarse sizes—1½ in. to + 4. It was found that the relative percentages of ferrosilicon and magnetite, as well as the specific gravity of the liquid, were of critical importance in the efficient operation of the plant.

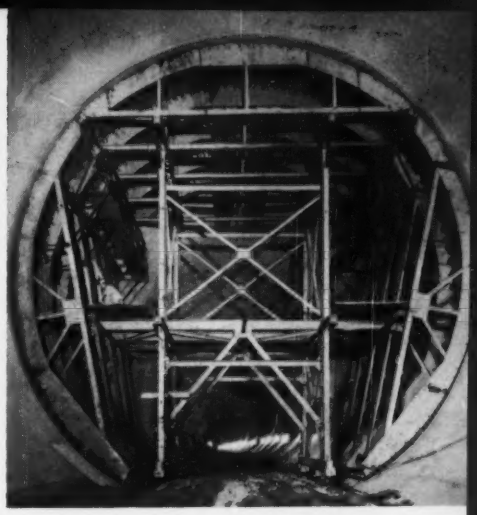
With objectionable material removed, gravel was carried by conveyors to a rescreening tower and then conveyed to sized storage piles for later trucking to the aggregate stockpile at the dam site. Sand was reblended and stockpiled.

To transport the aggregate from Wahweap to the storage stockpiles at the dam site a belt conveyor and motor trucks were considered. To employ the latter it would be necessary to construct and maintain five miles of new roadway, but this was found more economical than to install a conveyor five miles long. For hauling, 30-ton Cook Brothers bottom-dump semi-trailers, loaded by a 1½-cu yd shovel, are used. The gravel-surfaced haul road has a maximum adverse grade of 1½ percent; an average run takes 20 minutes.

Half a mile from the main batching plant, the bottom-dump trucks are unloaded into hoppers. A belt conveys the aggregate onto an overhead shuttle conveyor, whence it is deposited in graduated stockpiles. The height of the shuttle conveyor permits stockpiles 80 ft high. The largest size of aggregate handled in the pilot plant is 2½ in.; in the enlarged permanent plant, it will be 6 in.

The main aggregate plant, currently under construction, is a short distance from the pilot plant and will be eight times as large. It will have an input capacity of 1,400 tons per hour and a usable output of 800 tons per hour. The process will be the same as that employed in the pilot plant, but on a considerably larger scale. The plant is expected to have two 6½-cu yd draglines feeding onto a belt conveyor 36 in. wide, which ultimately will reach out about three miles.

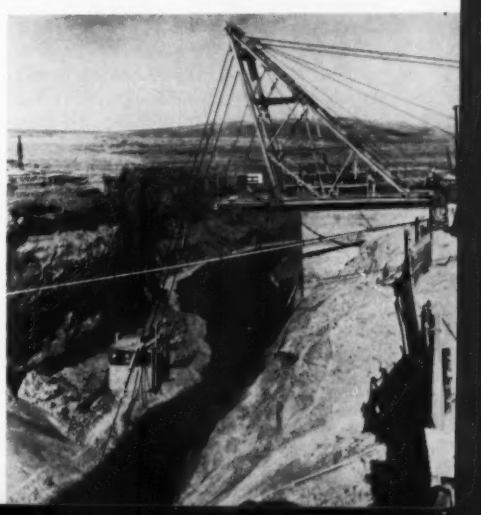
The screen tower will have two lines of 6 x 16-ft screens and a battery of sand classification equipment. The washed and segregated aggregates will be conveyed from the screening tower to a system of bunkers with capacities varying from 3,000 to 4,000 tons. The bunkers will be in line with a drive-under roadway, and each bunker will have from two to three gates 15 ft



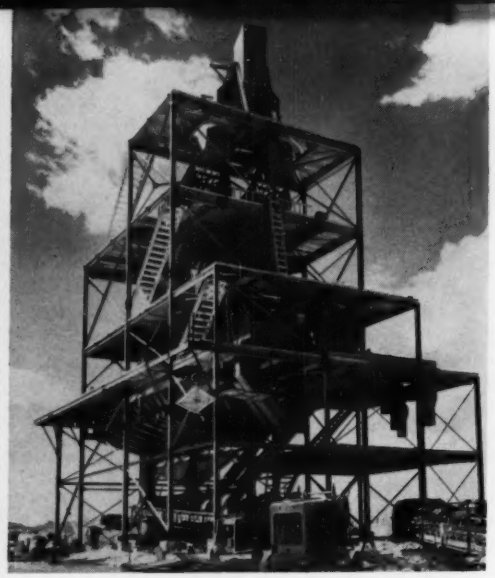
Diversion tunnels, 41 ft in diameter, were lined with concrete containing high-specific-gravity aggregate, placed back of Blaw-Knox forms.

Glen Canyon Bridges now permit easy access to opposite rim. Before construction started, a 200-mile trip was required to reach the opposite rim.

The "monkey-slide," a cable-guided, inclined elevator, is used to transfer personnel and light materials between the canyon's rim and its floor.



One of the early problems at Glen Canyon was separation of light aggregate material from acceptable gravel. This pilot plant uses a flotation process to reject gravel with a specific gravity below 2.5.



Utilizing ideas developed in the pilot plant, this structure will be used in processing the aggregate needed for nearly 5,000,000 cu yd of concrete.

long. The system will be so constructed that a truck of 30-ton capacity can be driver loaded in about 10 seconds. Twelve 30-ton bottom-dump trucks are expected to handle the capacity of the plant and maintain stockpiles at the batch-plant reclaim piles.

One of the contractor's early problems was to obtain wash and mix water for the aggregate and concrete plants. Pumping 700 ft up from the Colorado and then inland to the gravel source was not practicable because of the high solids content of the river. Little water can be taken from Wahweap Creek, primarily because the water is very high in soluble salts. To comply with specifications, the soluble salts would have to be removed from the sands and this could not be done without introducing a water of low sulphate content.

Surveys showed that a limited supply of water could be secured from wells. A series of four wells, with a total yield of about 6,000 gpm were drilled in the vicinity of Wahweap Creek. This is enough for the pilot plant, but is not sufficient for the main plant. To make up the deficiency, the well water will be blended with a small amount of water from the Wahweap.

With the supply of water so limited, it was necessary to construct a storage facility. An earth reservoir, 150 ft by 250 ft and 15 ft deep, was cut out of the desert and lined with a heavy plastic. It has a maximum capacity of 4,500,000 gal.

An extensive distribution system, which includes 5 miles of 20-in. pipe, carries water from the reservoir to all parts of the contractor's construction plant. For example, a 20-in. pipeline runs parallel to the aggregate haul road.

World's largest concrete plant

With more than 5,000,000 cu yd of concrete to be placed in the dam and powerhouse, the batching operation is certainly one of the most important features of the Glen Canyon Project. There will be 4,770,000 cu yd in the dam itself and 250,000 cu yd in the powerhouse. Nearly 100,000 cu yd have already been placed in tunnel lining and in the contractor's plant.

A temporary Johnson batch plant has been constructed adjacent to the permanent aggregate storage stockpiles. It is equipped with two Koehring 4-cu-yd tilting mixers and has a maximum capacity of 150 cu yd per hour. The main batching plant is under construction on an excavated ledge adjacent to the west keyway, 170 ft below the rim of the canyon and directly below the refrigeration plant. This location gives best overall operating characteristics in lowering or raising the concrete required. Concreting of the dam is scheduled to begin in November 1959.

Glen Canyon's main batching plant, supplied by Noble under a million-dollar contract, is believed to be the largest ever utilized for dam construction. It is rated at a storage-bin capacity of 3,000 tons and will be 217 ft high from bearing plate to screen tower. A series of screens will separate the aggregate into eight bins. Four will contain aggregate ranging from 6-in. cobbles to that retained on a No. 4 screen, two will be for heavy-media gravel; and the other two will be for sand—one natural and the other for heavy media.

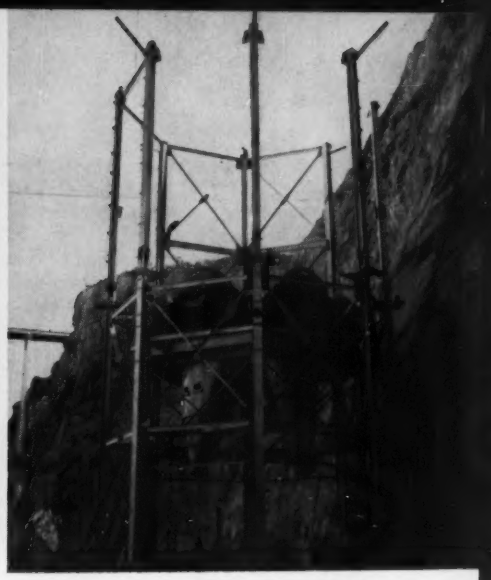
Adjoining the plant's storage bin are two surge silos—one for cement, the other for pozzolan. Specifications of the Bureau of Reclamation require that pozzolanic material be included in the mix to improve the quality of the concrete and reduce the heat of hydration as well as the cement content.

Under the storage bins will be the mixing deck, where six 4-cu-yd Smith mixers, arranged in a circle, will provide 480 cu yd of concrete per hour—an average of 3 minutes per mixer for each cycle. The huge mixers, 13 ft long, 12 ft wide and 12 ft high, are charged by a revolving feed spout that travels in a circle. The mixers are fitted with removable hard-faced liner plates to take the beating from up to 6-in. aggregate. The mixers are tilted pneumatically to feed into two 26-cu yd wet-batch hoppers and one 13-cu yd hopper. Interior concrete will be unloaded into the larger hoppers. The face concrete—containing beneficiated aggregate—will go into the smaller hopper.

Weighing of materials, batching and unloading of the concrete into the wet-batch hoppers is entirely automatic. An electronic tape will automatically record the content, cycle and time of every yard of concrete mixed. One man will operate the entire plant.

On the rim of the canyon, a short distance from the main batching plant, seven steel silos have been erected, each of 10,000-bbl capacity. They hold 40,000 bbl of portland cement and 30,000 bbl of pozzolan. Cement for the project will be hauled by truck a distance of 185 miles from a new plant constructed by American Cement Corp. at Clarkdale, Ariz. The pouring schedule of 9,600 cu yd per day will require the

One of the largest refrigeration plants ever built rises on the rim of Glen Canyon. The Frick compressors, and the cooling tower in the background, will keep concrete below 50 deg F at all stages of construction.



The six 4-cu yd Smith mixers will be charged by a revolving spout from the 3,000-ton-capacity Noble batch plant.

delivery of 4,900 bbl per day. Cement and pozzolan will be fed from the silos to the batch plant through air slides. Mass concrete for the dam is expected to require 188 lb of cement and 94 lb of pozzolan per cu yd.

Huge ice plant

Concrete at Glen Canyon, like all concrete in large dams, must be cooled before it is placed. Here the concrete may vary only between 50 and 40 deg F when placed despite desert temperatures of 110 deg in summer. To cool the more than 4,770,000 cu yd of concrete that will be placed in the dam proper, Merritt is erecting a refrigeration plant that will be the largest single industrial installation ever assembled in the United States. It will develop in excess of 4,000 tons of refrigeration with a total connected horsepower of more than 7,000. In the summer of 1960, the system's ice plant alone will produce the equivalent of 50,000 tons of ice—probably more than any other single ice plant in the country.

The refrigeration plant consists of five parts: (1) an aggregate-cooling system that employs chilled water; (2) an air-cooling system at the batch plant; (3) a mixer-water cooling system; (4) an ice-making and ice-batching system; and (5) an after-cooling system through pipe embedded in the dam itself.

The aggregate will be sprayed with ice water at the rate of 3,600 gpm for a period of one minute while en route from stock piles to storage bins. By this means it is cooled 15 deg. In the bins the aggregate will be further cooled by air refrigeration to 30 deg F. Ice water and chipped ice will be added in the mixers. The ice will be transported from the refrigeration plant to the batching plant by a belt conveyor.

Final cooling takes place after the concrete block has been placed in the dam. A pipe coil for the circulation of water or brine will be embedded in each concrete block. More than 3,000,000 ft of 1-in. cooling pipe will be embedded in the dam.

Concrete placing

In the placing operation, special tilt-type transfer cars will carry the concrete from the batch plant over a structural-steel trestle constructed across the right keyway 175 ft below the crest of the dam. Cars will unload into cableway buckets on a landing platform along the outboard edge of the trestle.

An electrically driven car, powered from a third rail, and an idler car will each carry a 12-cu yd plus ladle. The transfer car is positioned directly over a cableway bucket; an air-activated cylinder tilts the ladle to dump the concrete.

Fifty-ton cableways

All three cableways used for placing concrete in the dam and powerhouse are equipped with movable head and tail-towers. Two are of 50-ton capacity —an all-time record load for a traveling cableway. They are equipped with the most modern electrical and mechanical units, and their hoist speeds of 600 to 700 ft per min are believed to be the fastest of any cableway. The two 50-ton cableways will be used primarily for placing concrete in the dam proper. The third cableway, a 25-ton unit to handle an 8-cu yd bucket, will be used for powerhouse concreting and material handling. Hoisting speed on this highline is 450 to 500 ft per min.

With its 5,000,000 cu yd of concrete, Glen Canyon will be the third largest dam in concrete volume in the United States, exceeded only by Grand Coulee, with 10,000,000, and Shasta with 6,535,000. A trestle and revolving cranes were used at Grand Coulee, and seven radial cableways at Shasta. At Hoover Dam, probably the most similar in construction methods to Glen Canyon, eight traveling tower cableways were used to place 3,250,000 cu yd of concrete.

The speed of Glen Canyon's three cableways and the size of their buckets were calculated to permit the contractor to maintain an average concrete placing rate of 9,600 cu yd per day during peak concreting periods. Allowing for a slower rate of placing at the start and during topping out, concreting of the dam and powerhouse is planned to cover a period of 38 months.

The two 50-ton cableways are at different elevations so that one can pass directly over the other. Each works independently of the other between two A-shaped traveling towers. The main gut of these cableways is the largest and strongest of its kind ever fabricated —a single lock-coil cable 4 in. in diameter, fabricated by American Steel & Wire Division of U. S. Steel Corp. The higher cable spans 2,050 ft, and the lower 1,800 ft. Towers of the higher cableway travel on a 910-ft-long track made of 175-lb rail. The lower unit has a lateral travel distance of 810 ft.

The head-tower for each cableway, which contains the unit's mechanical

and electrical equipment, is located on the east side of the gorge. The tail-towers house the takeup hoist. Maximum tower height is 189 ft.

With the exception of local stiffening for concentrated loads, all members of the tower structure—the four legs and all bracing—are fabricated from wide-flange beams. To accommodate the required pull of the main gut, plate stiffening was used at the head of each tower. High tensile steel bolts were used for field assembly, the shop subassemblies being all welded or riveted.

Outrigging platforms, erected on top of all four towers, provide maintenance facilities for the assemblies. Each tower is mounted on 32 wheels—four identical eight-wheeled trucks equipped with electric-gear motors. To equalize the overturning moment of the towers, reinforced concrete counterweights were placed across the vertical legs of all towers.

Housing for mechanical and electrical equipment is on the lower platform of the head towers, directly in front of the counterweights. To carry power and control wiring to the traveling towers with a minimum of cable maintenance, special flexible cables are mounted on steel hangers and strung like a shower curtain parallel to the tower tracks.

Each of the four eight-wheeled trucks under the tower legs is powered by a 40-hp a-c wound rotor gear-motor, directly connected to one of the four truck axles. Maximum travel speed of the towers is 120 fpm. Controls keep the tail-tower always in alignment with the head-tower and prevent travel beyond the rail limits.

The carriage assembly rides on two 10-wheel units, on the 4-in. lock coil cable. The main fall has three sheaves set in tandem, with six parts of 1⅛-in. wire rope running to an equalizer beam that handles the 12-cu yd bucket. A 1½-in. wire rope serves as an endless conveying line between the carriage assembly and the towers.

The hoist line is powered by a single drum grooved for 1⅛-in. wire rope. The drum is 106 in. in diameter, has a face width of 96 in. and can wind 2,180 ft on the first layer.

Six differential carriers—three on each side of the carriage assembly—are used as moving hangers to prevent sagging of the hoist rope. Use of the differential carriers limits the maximum unsupported length of the hoist line to about one quarter of the cableway span.

Operation of each 50-ton cableway is handled by one man. Controls for both units are located in a house on the west bank, level with the trestle tracks and within sight of the landing platform where concrete is transferred to the cableway. On the operator's control panel are a series of levers, buttons and switches that permit handling 12 cu yd of concrete with ease. Buckets can be lowered or raised while the carriage is moving.

Hauling speed ranges from 1,200 to 1,400 fpm. Combined with the units' record hoist speed of 600 to 700 fpm, this will make it possible to place more than 8 cu yd per minute with the two cableways. Electric power for the main hoist equipment will be supplied at 4,160 volts, and power for the tower propulsion motors will be stepped down to 440 volts.

Power for Glen Canyon

Power needs for the huge construction plant and the estimated population of 5,000 in the town of Page had to be met promptly. Closest source of power to the dam site was 135 miles away, over the rough terrain of northern Arizona, where storms could cause outage and delay. Estimates indicated that a temporary power plant could be built and operated for less than the cost of buying energy and bringing it to the site.

Maximum generating capacity of the power plant will be 16,500 kw at an 0.8 power factor at the peak of construction. It will consist of four Fairbanks-Morse 1,960-hp diesels with Westinghouse generators and ten English Electric diesel generators of similar size.

Generation of power is at 4,160 volts, 3-phase, 60 cycles, with distribution at 4,160 volts and 12,000 volts. The plant will have a connected load of about 20,000 hp, plus 5250 kw for lighting. Nearly half the horsepower output, 8,428 hp, is required just to service the batching and refrigeration plants.

By the time the first concrete is placed in the dam proper in November, Merritt-Chapman & Scott will have spent ten million dollars for construction plant. More than 2½ years of careful detailed work and planning will have been completed and a plant equipped with every modern device—tailored to meet the specific needs of this project—will be ready for one of the most rapid construction schedules in dam construction history.

The traditional ceremony of the "first bucket of concrete" will, in a sense, be an anticlimax compared to the long period of preparation that made it possible. Concreting is but one phase of a detailed, coordinated plan of attack that had to be mapped by the contractor when the job was first estimated, weeks before the actual bid was entered.

On a project of any size, large or small, it takes a well coordinated team of experienced personnel as well as equipment and material to do the job. At Glen Canyon, Merritt-Chapman & Scott's work force currently totals 1,200 men and at the peak of construction it will number about 2,500. The company's operations are under the overall supervision of William Denny, Executive Vice President in charge of the Construction Department, with Allen R. Bacon, F. ASCE, Project Manager, heading up the field force. For the Bureau of Reclamation, L. F. Wiley, Project Construction Engineer, is in charge of work at the site.

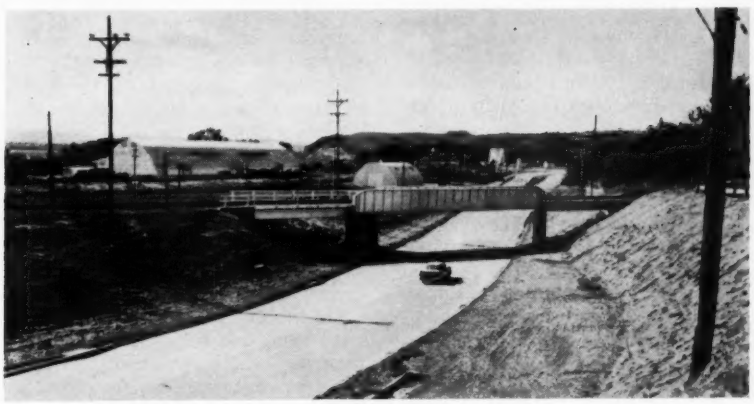
(This article is based on Mr. Peraino's talk at the ASCE Los Angeles Convention, before the joint session of the Construction and Power Divisions.)

A temporary power plant helps to build a power dam. In foreground is one of four Fairbanks-Morse diesel units connected to Westinghouse generators. Beyond are ten English Electric diesel-generator sets.

The National Highway Program

--a progress report

Before and after photos show how elimination of sharp, blind turns on rural roads can do much to increase road capacity and decrease accidents.



ELLIS L. ARMSTRONG, M. ASCE

Commissioner, Bureau of Public Roads

U.S. Department of Commerce

Washington, D. C.

During this summer, across America on the Federal-Aid Highway System, nearly 6,000 highway contractors with 350,000 pieces of major equipment will be at work on their biggest roadbuilding season so far. Among other accomplishments they will move nearly 20 million cu yd of earth and rock each working day, as they will every working day for the next twelve construction seasons in the job of creating our modern highway system.

Modern America is truly a nation on rubber-tired wheels. By the end of this year we expect that our 70 million automotive vehicles will have chalked up a record for the year of nearly 700 billion vehicle-miles of travel on the highways. The direct cost of operating these vehicles, exclusive of drivers, will be over $75 billion for the year. One job in every seven is in the automotive industry. We now have nearly 2½ times the number of vehicles we had 20 years

Construction contractors have over 350,000 pieces of major equipment at work on highways this summer.

Traffic jams in and near urban areas, such as this near Washington, D. C., are aggravating, time-consuming, and costly.

ago on essentially the same highways. Future estimates appear in Fig. 1.

Since the inception of the accelerated National Highway Program, in July 1956, construction has been completed on over 73,000 miles of federal-aid highways, including 14,500 bridges. Of this, the Interstate projects involved only one-twentieth of the mileage but accounted for one-fifth of the cost.

Work is now actively under way on 20,000 construction contracts involving over 32,000 miles of roadway and 10,500 bridges, at a total cost of $7.2 billion. It is expected that by the last of July, when the construction season is in full swing, work on the federal-aid systems will increase to about $8.1 billion, an increase of over $2 billion since the same time last year.

The 41,000 miles of controlled access, complex superhighways comprising the National System of Interstate and Defense Highways are well along and comprise about 60 percent of the federal-aid work now under way. Since July 1956, contracts for the construction of 7,800 miles of Interstate highways, including 6,900 bridges, have been awarded and construction has been completed on 3,800 miles. Including the mileage constructed as toll roads and from other than Interstate funds, a total of nearly 5,000 miles of the Interstate System is now available to the motorist. Work is actually under way or completed on some phase—either construction, right-of-way acquisition, or preparation of plans and specifications—on 29,000 miles of the system, or about 70 percent of the total.

On the regular primary, secondary, and urban federal-aid systems (generally referred to as the ABC program), progress is equally impressive. Since July 1956, some 68,000 miles have been completed and construction is now under way on nearly 30,000 additional miles. In addition there is under construction $3.1 billion worth of roads financed entirely by state or local entities outside the federal-aid program.

On Interstate work nearly half the states have now begun to obligate by contracts the funds for the fiscal year 1960, which begins July 1. For the country as a whole the obligations for the Interstate System equal all apportionments up to and including 5 percent of the fiscal year 1960, with still two months to go in the fiscal year 1959. On the ABC program the progress is equally impressive; funds are obligated to the extent of about 94 percent of 1959 apportionments.

The program is on schedule and there is no doubt that it can be successfully accomplished as programmed providing adequate financing is forthcoming. Right now a serious and costly slowdown is threatening the Interstate program, a slow-down that could lose the momentum gained and seriously delay the program. This prospect is not bright.

The tight-money situation developed in this way. The 1956 Act authorized about $25 billion for the Interstate System, extending over the years 1956-1969. A Trust Fund was established to receive revenues from federal motor-fuel and certain other highway user taxes, and from it the federal funds for both the Interstate and ABC systems were to be drawn, the ABC apportionments to

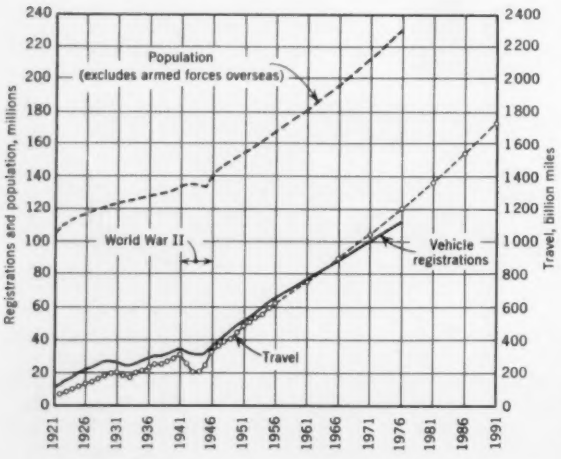


FIG. 1. Estimates of population, motor vehicle registrations, and travel are shown graphically for selected years.

have first call. The anticipated receipts and disbursements were estimated to be in close balance but not on a year-to-year basis. A provision, however, was included in the Revenue Act requiring that the authorizations be reduced if it appeared that the Trust Fund balance would be insufficient to meet payments to the states at the time they made claims for reimbursement.

Actually revenues going into the Trust Fund have exceeded slightly the original estimates, and there is now a balance in the fund of $492 million. However, the 1958 Federal-Aid Highway Act set aside the so-called pay-as-you-go clause for two years and increased the original Interstate authorizations by $800 million, stepped up the ABC authorizations above previous levels, and provided a special $400 million program, partly as an anti-recession measure.

As a result, the annual expenditures for the fiscal years 1959 and 1960 will exceed the annual revenues. Unless additional funds are provided, the pay-as-you-go clause, which will become effective after the two-year suspension, will make it necessary to forego completely the apportionment of the $2.5 billion of Interstate funds authorized for the fiscal year 1961, which normally would be made during July or August of this year. Further, the Interstate apportionment for the fiscal year 1962 would be limited to $500 million instead of the $2.2 billion authorized. For the remainder of the program the funds available for the Interstate system would amount to $1.7 to $1.8 billion a year, or about three-fourths of amounts authorized.

To prevent serious delays to the highway program, the President recommended a temporary increase in the federal motor-fuel tax of 1½ cents per gallon for a five-year period beginning July 1 of this year. This would allow planned construction to continue until Congress has the opportunity to review important data now in preparation, before deciding on the best method of financing the entire program. Current studies include the Bureau of Public Roads Highway Cost Allocation Study and the American Association of State Highway Officials gigantic road test in Illinois. With extensive data from these far-reaching studies available and a new estimate of the cost of completing the Interstate System in hand, Congress will be in a position in 1961 to take a fresh look at the over-all problem of federal responsibility and the equitable distribution of highway costs. The best course of action for completion of the program can then be determined.

It is not possible to predict what Congress will do but it is expected the legislators will find ways and means to keep the program going full speed ahead.

Advances in engineering are improving the quality of the new highways. The comparatively new tools of photogrammetry and aerial surveying, electronic distance-measuring apparatus, and geophysical techniques for subsurface exploration are receiving widespread application. The electronic high-speed computer, and the unbelievable speed with which computations can be made on it, is freeing engineers from routine repetitive computations and allowing solutions to be determined that heretofore were impossible in terms of time and manpower. It is now practical, for example, to compare the physical and economic factors of six or eight possible locations of a route in a shorter time than previously was required to analyze one or two. Bridge designers can select the best structure from a whole series of trials. Complex and extensive analysis of traffic origin and destination data can be performed.

More careful attention is being given to the hydraulic features of highway design. This is a much greater problem than formerly because of the wide rights-of-way required for controlled-access highways. The new electronic tools permit extensive hydraulic analysis.

So far 43 states have installed their own electronic computers. The Bureau of Public Roads now has a library of over 250 different computer programs and the list is growing. The development of new programs is actually of an accelerating nature.

The divided expressway made up of two separate roadways, each independently fitted into the topography to best advantage and with full consideration given to safety, headlight glare and esthetic values, is becoming accepted as the truly modern highway. Uniformity in signs and markings on the Interstate System is expected to make travel safer and more enjoyable. With the detailed analysis made possible by the work-saving tools available, plus imagination, vision, and careful design, these superior roadways can usually be produced at savings in construction cost.

Advances in knowledge concerning soils and soil behaviour in foundations and embankments have made more stable roadbeds possible at minimum cost. The techniques of designing and installing sand drains in low-strength foundations, surcharging of foundations to obtain settlement before the pavement is placed, and similar approaches are giving more economical, satisfactory roadbeds. Advancing knowledge of aggregates, of portland cement, of bituminous materials, is resulting in improved and more durable riding surfaces.

Along with the increasing mileage of road construction, there is a growing realization that research must be stepped up. Studies range from the X-ray diffraction of submicroscopic particles of clay soils to the huge $22 million road test in Illinois, where 836 different pavement sections and bridges of different design are being tested by a two-year driving test made up of varied loads applied by 60 trucks and combinations. The elaborate electronic tools used on this road test will produce and analyze a myriad of data that not so long ago could not even have been considered.

An outstanding development in highway research is in the field of highway capacity. A broad store of knowledge has been accumulated, and continues to be sought, on vehicle performance and driver behavior as affected by the traffic stream and road features. Only recently, a truck-mounted traffic analyzer was developed to increase our ability to collect and digest such data. Concurrently, the origin-destination surveys have provided information on travel habits and desires.

Urban planning is a relatively new sphere of research. Methods have been or are being developed to use the electronic computer in analyses of trip generation as related to land use, and the forecasting of trip distributions based on expected land development. The very latest development—and an important breakthrough—is computer methodology for the assignment of trip movements to an urban street system, exploring the potentialities of possible expressway locations.

In an entirely different application of research to highway capacity, a practical and valuable method has been developed to locate the bottlenecks on existing rural roads and determine the effects of spot improvements. A similar study, applied to urban thoroughfares, is now under way. From such studies come both improvements in design and economic evaluations of benefits—plainly put, getting the most for our money.

And in the field of highway safety, remarkable strides are being made in pinpointing causes of accidents and defining the problems. A 232-page report on this important subject has just been submitted to Congress by the Bureau of Public Roads.

All this progress is good. All the members of our profession should share a feeling of satisfaction in the accomplishments so far. There's a lot yet to be done—but we are on the way.

(This article is taken from Mr. Armstrong's address at the ASCE Cleveland Convention, before the General Membership Luncheon on Tuesday, May 6.)

Controlling floods on the Tennessee

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In the colorful history of the Tennessee Valley, devastating floods have figured prominently. It is essentially a wet region—one of the wettest in the nation. Since 1933, when TVA was given the task of doing something about this problem, many serious floods have been averted or held within manageable limits, a 650-mile navigable waterway has been created, and the power potential of the region had been developed.

Two recent flood control operations of unusual significance, to be discussed later, occurred in February 1957 and May 1958, when the damages averted are estimated at near $74,000,000.

The Valley

The watershed of the Tennessee Valley bounds an area of 41,000 sq miles. The terrain varies from rugged mountains along the eastern rim to the broad valleys and rolling country of the western areas. Principal tributary streams fall from the Blue Ridge Mountains and from the Cumberland Plateau. The main stem of the Tennessee River curves crescent-shaped from Knoxville southwestward and then to the northwest to the Ohio, a distance of 650 miles. See map, Fig. 1. In this course, it falls 500 ft. The high eastern valley rim reaches elevations of more than 6,000 ft above mean sea level. At the mouth of the Tennessee, the flood plain is slightly above El. 300.

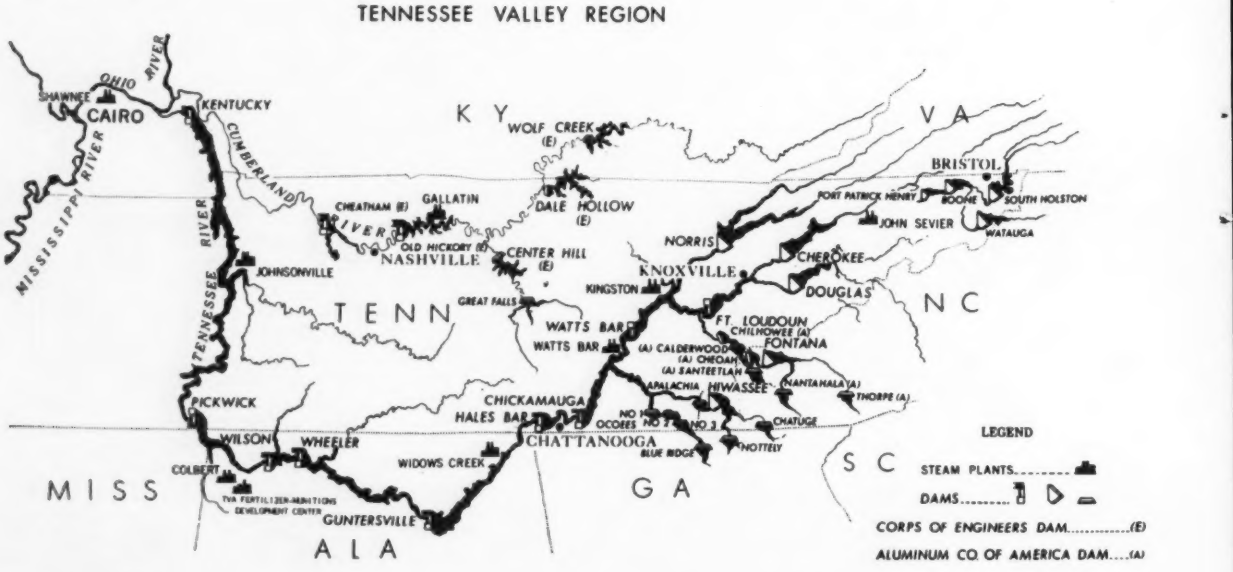
Rainfall averages 52 in. annually for the valley as a whole. Locations in the mountainous southeastern section show annual averages in excess of 90 in.; other areas average less than 40 in. The greatest yearly total recorded is 133.3 in. in 1957 at Haywood Gap, N. C. Annual totals for the valley range from 38 in. in 1941 to near 65 in. in 1957.

In general, seasonal variations in rainfall are not pronounced. The months of August, September, and October are typically on the dry side. For most of the valley, the winter months produce the largest amounts, but in some eastern areas the July rainfall is greatest.

Streamflow records, however, show a strong seasonal pattern in which the high flows of the winter and early spring months stand out clearly. Flows decline usually during summer and fall and recover in December.

Occurrence of great valley-wide floods fits the seasonal runoff pattern. This is illustrated by the flood history chart for Chattanooga since 1867 (Fig. 2) which shows that all the large floods occurred between late December and early April. The extreme irregularity

FIG. 1. TVA reservoir system in Tennessee Valley includes 31 major hydro projects, of which 19 are multiple-purpose. Nine of the latter are on the main Tennessee River. In this system at least 11,800,000 acre-ft of flood storage capacity is available on January 1 of each year.



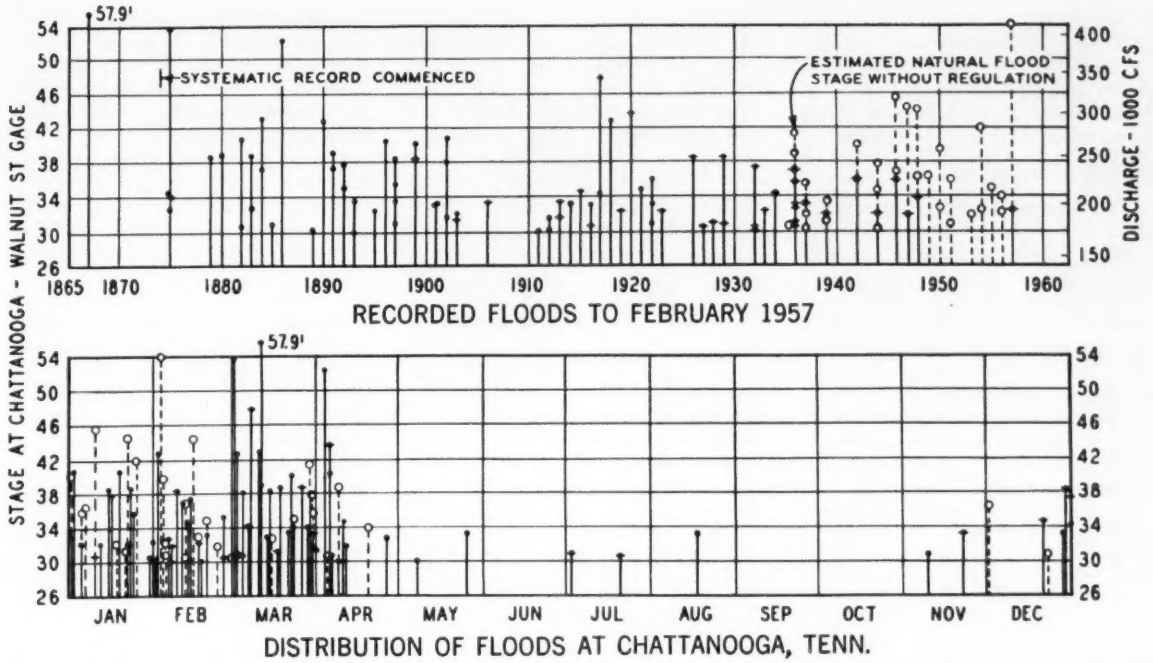


FIG. 2. All the large floods at Chattanooga have occurred between December and early April, but occurrence by years is highly irregular. Largest occurred in 1867, second largest in 1957.

with which large floods occur is also evident. The largest occurred in 1867 and the second largest in 1957.

System planning

The TVA Act directed a unified approach to resource development, and carried some specific guide lines for the development of the river. Navigation was to be provided by a channel of 9-ft draft extending from the mouth of the Tennessee River to Knoxville. Destructive floods in the Tennessee and Mississippi River Valleys were to be controlled. Power potential created by the construction of dams was to be fully developed. While these aims were clear, they left ample room for determination of the best over-all solution.

One of the early major decisions in system planning was the choice of high dams on the main stem of the Tennessee River. The alternatives considered were a system of some 30 low dams for navigation only, as compared with a series of nine high dams (including two existing dams) that would provide the required navigation channel but also would create flood storage capacity and a power potential of 1,651,000 kw. The choice of high dams increased the effectiveness of the system for flood regulation along the Tennessee River and also permitted dependable and substantial reductions in flood stages on the Ohio and Mississippi.

Flood control planning focused on two key areas—the flood-vulnerable middle Tennessee Valley area at Chattanooga, and the lower Ohio-Mississippi region.

The most effective plan for fully adequate protection at Chattanooga against floods of "maximum probable" proportions was found to be a combination of upstream reservoir storage and local protective works. Consideration of feasible levee heights at Chattanooga and available upstream reservoir sites led to a plan for the provision of 4,000,000 acre-ft of flood storage capacity distributed throughout the tributary streams of the upper valley. This amount of reservoir capacity was to be available in mid-March, with greater amounts required at the outset of the flood season late in December.

Major reservoir sites identified on the five principal tributaries above Chattanooga would control a combined drainage area of 13,420 sq miles. A storage capacity of 4,000,000 acre-ft, distributed uniformly over the drainage area, would be equivalent to about 5.6 in. over this area. As a result of adjustments for average contributions to Chattanooga floods, unit storage costs, and physical site limitations, the flood storage provided in mid-March varies from 4.2 in. at Douglas on the French Broad River to 8.9 in. at Norris on the Clinch River. Additional storage capacity was planned at main-river projects upstream from Chattanooga as follows: Fort Loudoun, 1.30 in.; Watts Bar, 2.16 in.; and Chickamauga, 2.46 in.

The second key planning objective was to contribute flood relief to the lower Ohio-Mississippi Valley. Fulfillment of this objective was possible for two reasons: (1) the unregulated contribution of the Tennessee River to Mississippi River floods is nearly always substantial and has been as great as 30 percent of the peak discharge at Cairo, Ill.; and (2) the availability of a massive reservoir site, the Kentucky project, would provide 4,000,000 acre-ft of usable storage control at a point only about 20 miles from the mouth of the Tennessee River. Because of this favorable location, regulation of Tennessee River discharges at Kentucky Dam is effective on the Ohio and Mississippi River almost without diminution. A comparison of the volume in the crest of Mississippi River floods with the volume of Tennessee River floods during a corresponding period of time, adjusted for water travel time, shows that reductions of from 2 to 4 ft can be accomplished in major floods.

Between the Kentucky Reservoir and Chattanooga, five main-river projects create the navigable channel, develop the power potential, and provide limited amounts of flood regulating capacity. Their flood control function is to supplement the upstream regulation

in the protection of communities and land along the lower Tennessee River by short-term regulation during flood crests. They also supplement the Kentucky Reservoir in reducing flood crests on the Ohio and Mississippi.

Operation sequences

The reservoir system in the Tennessee Valley which TVA, over the past 25 years, has built, acquired, and integrated into its operations, consists of 31 major hydro projects, of which 19 are multiple-purpose (Fig. 1). Nine of the multiple-purpose projects are on the main Tennessee River and provide the navigation channel from Knoxville to the mouth. The remaining ten are located strategically on the principal tributary streams above Chattanooga. The twelve single-purpose power projects include six owned by the Aluminum Company of America and six of TVA. For this system, a total of at least 11,800,000 acre-ft of flood storage capacity is available on January 1 of each year. As the flood season progresses, this reservation may be reduced to 10,400,000 acre-ft in mid-March. A total of nearly 2,500,000 acre-ft is held available for flood control operations during the summer months.

The operation of the reservoir system for flood control at Chattanooga follows the pattern of: (1) storage in tributary reservoirs, (2) rapid discharge of early flows through the main-stream reservoirs, (3) storage in main-stream reservoirs during the period of crest flow, and (4) post-flood drawdown of main-stream and tributary reservoirs to flood control levels.

At the tributary reservoirs, excess flows are stored throughout the period of regulation for Chattanooga. If these reservoirs are below flood reservation levels, discharges are limited to turbine capacity or less. As storage space above these levels is filled, discharges may be increased gradually to insure retaining control in case a flood of extreme proportions should occur.

At main-stream reservoirs, the early buildup of flows below the tributary reservoirs is passed rapidly downstream, reserving storage space for regulation of the crest flow. If practical, advance drawdown is made at the dams to provide additional storage space. As the flood develops and the river at Chattanooga reaches near flood stage, regulation is begun. Releases at Chickamauga Dam are adjusted to reduce the Chattanooga crest stage as much as prudent operation indicates. As at the tributary reservoirs, the release must be controlled, depending on the magnitude of the flood, so as to reserve some margin of reservoir volume in case higher flows should develop.

As soon as the crest stage is passed, drawdown of main-stream and tributary reservoirs is started to make ready for additional flood flows. Outflow rates are adjusted to maintain full channel conditions downstream and thus to accelerate the withdrawal.

Operation of the Kentucky Reservoir for the lower Ohio-Mississippi Rivers follows a different pattern. The objective is not a flat, regulated outflow, but an outflow which, combined with Ohio-Mississippi River flows, will produce the desired flat, regulated crest on the Ohio River at the Cairo gage. Flood crests on the lower Tennessee are not usually coincident with those on the Ohio-Mississippi. High discharge rates from Kentucky Reservoir are usually possible early in the flood period, and the reservoir at the dam may be drawn down from the normal level of El. 354 to as low as El. 346. Releases are regulated as needed to obtain the maximum practical crest reduction.

The great 1957 flood

The January-February 1957 flood was the largest in TVA history and the second largest at Chattanooga in the 90 years of record beginning in 1867. It followed an extended period of below-normal runoff. Tributary storage reservoirs had been drawn lower than the required flood levels in supplying water for power. The system was ready as planned, with some room to spare.

Rainfall was first reported in the Valley on January 21, and continued, with only a one-day break, for 21 days, averaging 11.7 in. in this period over the 41,000 sq miles of the Tennessee Valley. Of this total, 7.3 in. occurred between January 27 and February 2.

Inflows to tributary reservoirs were greater than any experienced in TVA history. Releases from these reservoirs were limited to turbine capacities for the period of regulation for Chattanooga. Post-flood drawdowns, however, required supplemental gate discharge from South Holston, Cherokee, Douglas, and Norris Reservoirs. During the flood period, rises in major multiple-purpose tributary reservoirs ranged from 37 ft at Norris to 70 ft at Fontana. Water stored, in inches of runoff from their drainage areas, ranged from 3 in. in Douglas to near 7 in. in South Holston. Typical of tributary reservoir operation during the flood period, is that of Douglas Reservoir, shown in Fig. 3.

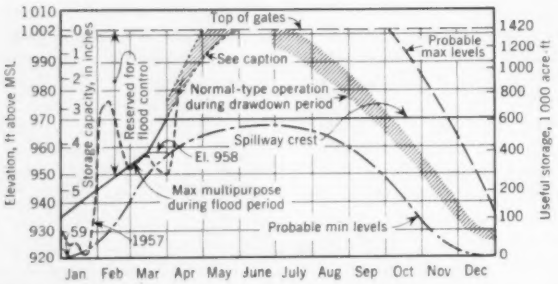


FIG. 3. Typical of reservoir operation on a tributary is that of Douglas Reservoir during 1957 flood. Hatched band at left marks normal limitations on filling or drawdown after flood, between April 1 and June 1, although hydrological conditions and levels in other reservoirs may change the picture.

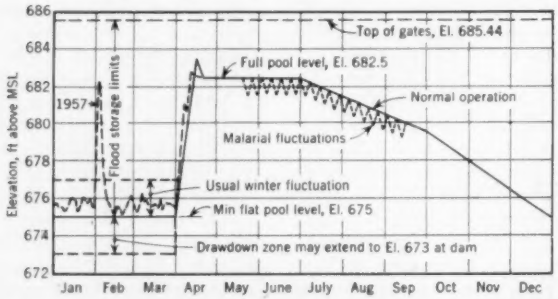


FIG. 4. Typical main-stem reservoir operation is illustrated by Chickamauga in 1957 flood.

Inflows to the main-stream reservoirs above Chattanooga were regulated to a maximum discharge of about 180,000 cfs at Chickamauga Dam. About 60 percent of the flood storage space in these reservoirs was filled in the regulation. The operation of Chickamauga Reservoir, shown in Fig. 4, is typical of main-stream reservoir operation. The river at Chattanooga crested at a stage of 32.24 ft on February 2 and remained above flood stage of 30 ft for about six days.

Computations show that the flood, without the regulating effect of the TVA multiple-purpose reservoirs, would have reached a stage of 54 ft at Chattanooga, within only 4 ft of the record flood of 1867. This would have been 24 ft above the flood stage and 21.8 ft higher than the stage that occurred. The area covered by the actual flood at Chattanooga and the area that would have been flooded without the TVA reservoir system are shown in Fig. 5. Damages averted at Chattanooga are estimated at $66,000,000.

Below Chattanooga, regulation also resulted in substantial stage reductions, which limited serious flooding at the Redstone Arsenal and prevented overtopping of TVA's huge cofferdam for the new Wilson Lock, then in the early stages of construction. Kentucky Dam storage was held in reserve in case a serious Ohio River flood should develop but over-all system operation resulted in a 1.5-ft reduction in the Cairo crest. Regulation at tributary dams also produced substantial benefits locally downstream, particularly along the Clinch River below Norris Dam. Damages averted in the vicinity of Clinton amounted to about $250,000, in addition to much more substantial damage that would have occurred to AEC installations at Oak Ridge.

Regulated floods, 1936-1958

TVA operations for flood control date from March 1936 with the closure of Norris Dam. The March-April flood period of that year resulted in an observed crest stage of 37.1 ft at Chattanooga, a stage not exceeded since that date, but 4.2 ft lower than the natural stage that would have occurred without the Norris Dam regulation. With the completion of Kentucky Dam in 1945, the flood control system for the Tennessee Valley and the lower Ohio and Mississippi was essentially complete.

Within the next three consecutive years of 1946, 1947 and 1948, the fifth, sixth and seventh largest floods in the record to 1948, at Chattanooga, occurred. They were successfully regulated to stages involving minor damages only.

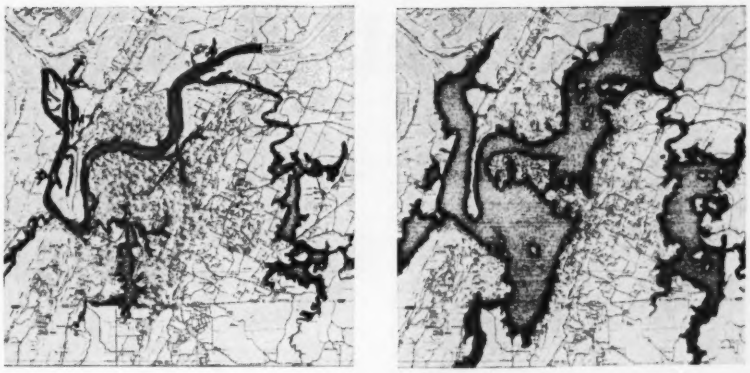


FIG. 5. Actual area flooded at Chattanooga in February 1957 (left) is compared with "the flood that would have been" (right).

The 1950 flood on the Ohio River, which produced the third highest stage of record at Cairo, was lowered 1.8 ft. The greatest stage reduction and savings in damages at Chattanooga were obtained in the January-February 1957 flood. Although it was the second largest flood of record, the distribution of runoff was favorable, and it at no place taxed the regulating capacity of the system. The largest stage reduction and savings in damages on the lower Ohio and Mississippi Rivers resulted during a flood in May 1958, when the stage at Cairo was reduced 3.1 ft.

During the 23 years since the closure of Norris Dam in March 1936, stage reductions have been accomplished on 33 floods which would have exceeded flood stage at Chattanooga. The damages averted there now total $120,213,000.

The full effectiveness of the TVA system for controlling floods dates from the completion of Kentucky Dam in 1945. Damages averted along the lower Ohio-Mississippi Rivers since that date now total $20,088,000.

Benefits versus costs

The total investment in the multiple-use projects of the TVA system now stands at $744,000,000. In accordance with provisions of the TVA Act, $184,000,000 has been allocated to the flood control function, $159,000,000 to navigation, and $401,000,000 to power generation.

Estimated average annual costs on the allocated investment of $184,000,000 total about $7,000,000, including interest, amortization, and operation and maintenance. Average annual flood control benefits are estimated at $13,000,000, including benefits within the Tennessee Valley and those along the lower Ohio and Mississippi. The above annual costs and benefits, based on 1953 conditions, show a benefit to cost ratio of about 1.9:1.

Estimates of damages averted by virtue of flood reductions in actual floods since 1936 now total $140,000,000, or 76 percent of the total capital investment of $184,000,000 allocated to flood control. This total includes only damages at Chattanooga and in the lower Ohio-Mississippi River Valleys, since it has not been practicable to accumulate damages averted at other locations in the Tennessee River Basin.

Increased land value in the Ohio-Mississippi region, by virtue of greater security against floods for some 6,000,000 acres behind the levee system, cannot conveniently be estimated by years. It appears more logical to consider that such benefits accrued in total immediately upon completion of the protective works. This benefit from the TVA system, estimated at $150,000,000 plus the incomplete total of $140,000,000 for damages averted, makes the total accumulated benefits to date in excess of $290,000,000.

Flood control costs to date, including the capital investment of $184,000,000, an allowance for interest of $67,000,000 on the undepreciated investment, together with operation and maintenance expenditures of $19,000,000, would total $270,000,000. Comparison with accumulated benefits shows that benefits over a period of only 23 years are more than sufficient to amortize the entire flood control investment, plus all accumulated annual expenditures and an allowance for interest.

(This article is based on the paper by Messrs. Elliot and Engstrom presented at the ASCE Hydraulics Division Conference in Atlanta, Ga. In briefing it for use in CIVIL ENGINEERING *it has been necessary to delete data on cost allocation and normal-year operation. Full data may be obtained from the TVA at Knoxville, Tenn.)*

DOUBLE-WALLED RESERVOIR

Circular piers take thrust of 30 ft of fill outside or water inside while providing open space to prevent contact with ground water.

for potable water, built rapidly with ingenious forms

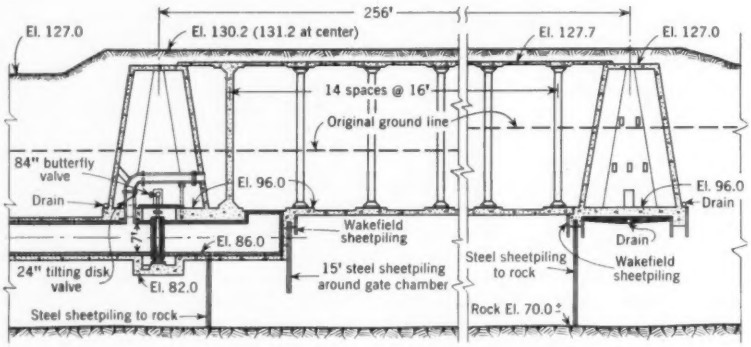
E. E. EASTERDAY, M. ASCE, Chief Engineer, Design and Construction, Department of Public Utilities, Water Division, City of St. Louis, Mo.

A double-walled clear-water basin designed for safe underground storage of 10,000,000 gal of purified water, as well as for economical construction, now serves the Chain of Rocks Purification Plant of the City of St. Louis. The hollow wall arrangement, with underdrains, forms a dry well that eliminates the possibility of contamination from high ground-water outside and overcomes the objection of the Missouri State Department of Health to storing purified water below ground level.

Double-counterfort piers on 16-ft centers support circular arched walls 12 in. thick on each side to form a hollow wall around the basin, which is 256 ft square. See Figs. 1 and 2. The exterior wall resists the thrust from more than 30 ft of earth fill. The interior wall counteracts the 30-ft head of water. And the space between the walls permits drainage, inspection and repair.

The arched concrete walls, being circular, are under direct compression. This feature provides some of the advantages of prestressed concrete without prestressing and reduces the tendency to leakage either through the walls or between the walls and the piers.

Struts tie the piers together in alternate cells only. See Fig. 2. This allows longitudinal expansion or contraction to flex the relatively thin arches in the cells without struts. The concrete covers over these cells have expansion joints through the center and are free to slide on the tops of the arches.



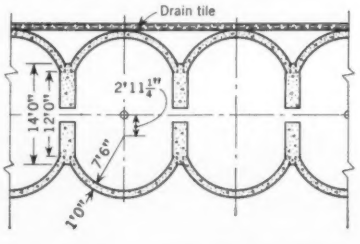
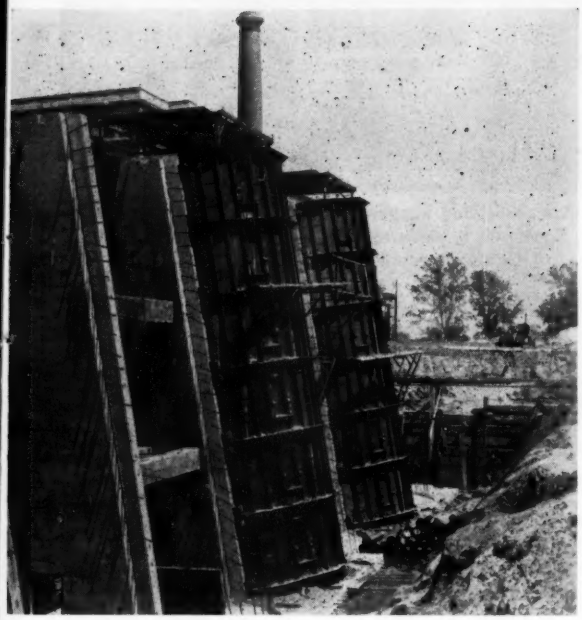


FIG. 1. Typical section through clear-water basin shows provision for drainage and cutoff to rock. The 84-in. rubber-seat butterfly valves were furnished by the Henry Pratt Co., and the tilting-disk valves by Chapman. Reservoir walls, seen in plan view at right, are composed of identical repetitive units of reinforced concrete.



The special circular forms were designed by A. M. Schultes, President of the G. L. Tarlton Contracting Co. and fabricated in Tarlton's shops.

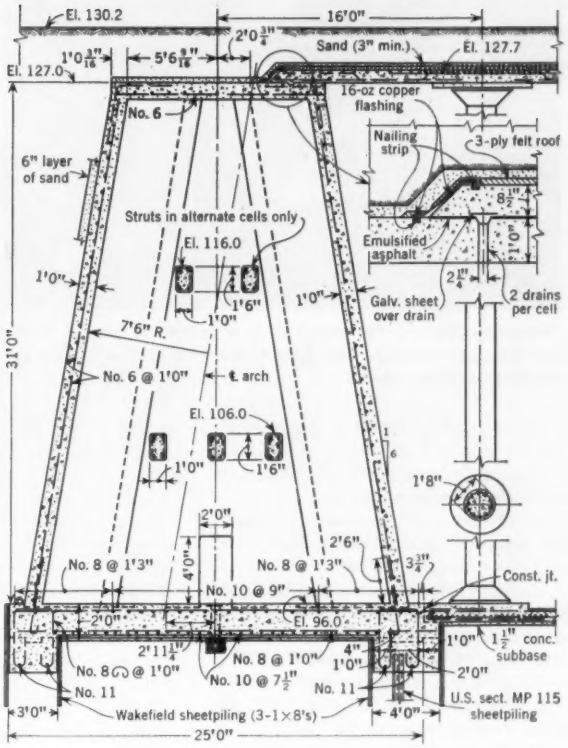


FIG. 2. Section through one cell of reservoir wall shows struts used in alternate cells only. Cover is designed to slide over the tops of the cells.

The hollow portion of a wide-base retaining wall tends to reduce the maximum toe pressure on the supporting soil. The maximum toe pressure on the outside of the retaining wall is almost balanced by the weight of earth just outside the wall footing. Therefore, the tendency of the wall to settle or rotate in this direction is almost zero. Unbalanced pressures on the inner toe due to earth backfill when the basin is empty are partly resisted by a row of steel sheetpiles under the toe, used as a cutoff wall continuous around the entire basin.

Lateral movement is resisted by concrete projections into the supporting soil under each edge of the wall footing, by the row of steel sheetpiling under the inside edge of the footing, by reinforcing bars tying the wall footing to the basin floor, and by the earth fill back of the wall. The steel sheetpiling under the wall footing also serves as a cutoff wall to slow any movement of water to or from the under side of the basin floor.

Both the floor and roof slabs are designed as level planes. This was done for several reasons. Level planes would expedite construction; no sediment is expected in a clear-water basin; and a slight slope does little good in cleaning or draining such a basin, since it has to be swept in any case. Conventional flat-slab construction is used for both the floor and the roof of the basin, the columns being spaced 16 ft in each direction (Fig. 1), which is also the center-to-center dimension between the wall cells. The floor slab is 8½ in. thick, with an additional thickness of 4 in. at the columns.

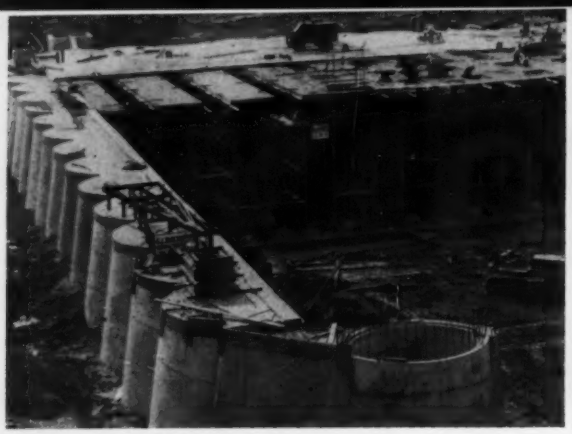
Leakage through the roof is prevented by tar and gravel roofing, a layer of sand over the roofing, and a sod-covered earth fill that slopes in four directions from the center. This should allow little or no water to reach the concrete roof, which is believed to be water-proof.

Earth fill was put on the roof to prevent spalling. It has been observed that a concrete roof over a water storage basin in St. Louis has a tendency to spall as a result of frost action. This spalling takes place even under an asphalt seal coat. An insulated roof deck would probably prevent spalling, but it is known that 3 ft of earth will do the job and limit maintenance to a lawn mower.

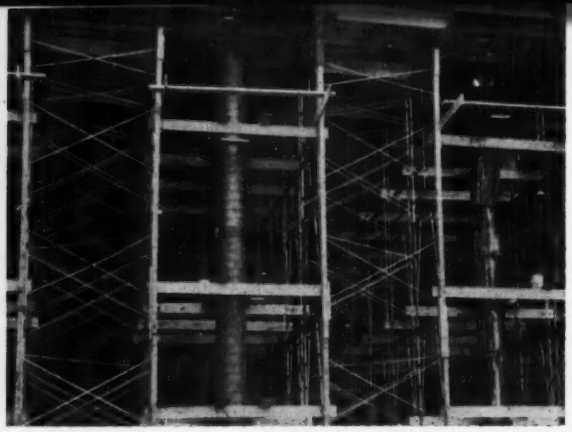
No expansion joints are provided in the basin floor or the wall footings. A rubber waterstop is used all around at the joint between the wall base and the floor slab. The roof slab is free to slide on top of the cell covers on all four sides of the basin.

The new basin was built between the filter plant and the pumping station, and the top of the basin walls is at the same elevation as the filters. This permits the water level in the basin to control the head on the filters and the flow through them, thus reducing the loss of head through the filter plant to a minimum. This arrangement is designed to stop flow through the filters in case of pump shutdown and to take any reasonable amount of fluctuation between the filters and the pumps.

Filling and drawing conduits are steel pipes completely encased in concrete. The filling conduit, 10 ft in diameter, passes through one of the cells above the footing. Two 7-ft drawing conduits, one of which is seen in Fig. 1, pass under the wall footing and connect to openings in the basin floor, making it



Forms are stripped by retracting screw-jacks. A hinged drop-leaf clears the columns and the 7 x 50-ft form section is skidded ahead in channel tracks.



Tubular scaffolding supports roof forms. Columns are formed with Sonotubes or sheet metal forms and cast in two lifts just ahead of the slab concreting.

possible to pump the basin dry if necessary.

Design features of the basin, which expedited construction, include:

1. The floor and roof are level parallel planes; therefore all columns and cells are of equal height.
2. Walls of constant thickness are composed of identical repetitive units except at corners; therefore form costs are reduced to a minimum.
3. Cells or piers can be omitted, without any special preparation, to leave gaps during construction for the passage of materials and equipment.

On November 5, 1957, twelve bids were received for building this clear-water basin. The low bid was $1,174,000 and the high bid was $1,483,858. The contract went to the low bidder, G. L. Tarlton Company of St. Louis, on December 8, 1957, the basin to be completed in 18 months. An 18-month construction schedule was prepared by the contractor, but on January 1, 1959, after 13 months, all the work was finished except a little backfill, seeding and some clean-up.

Construction progress and the methods employed by the contractor are illustrated by the accompanying photographs, taken during construction, which also show details of the basin.

Because of the waterlogged condition of the soil, excavation had to be done in such a way as to provide drainage and prevent disturbance of any soil below the subgrade. The specifications required that the last 3 ft of earth be removed with a clamshell, dragline or backhoe and that no traction equipment be used on any part of the wet subgrade. The earth subgrade was to be covered with a concrete subbase immediately after fine grading to provide a clean working surface strong enough to support forms and bar chairs.

Excavation was done in two stages. The first stage included excavation over the entire site to within about 8 ft of subgrade. This was accomplished with heavy grading equipment. The second stage, with dragline and clamshell, was done by first excavating a trench for the cellular walls, leaving about 8 ft of earth to be taken out of the center area. When the walls were completed, the remaining earth was removed to floor level with a clamshell bucket and cast over the top of the completed walls for use in the backfill.

Excavation for all trenches and wall footings was made between well-braced timber sheetpiling, which was left in place. The Wakefield-type piling was made of three rough 1 x 8's spiked together into a tongue-and-groove unit.

The basin walls were built in stages, by what could almost be called an assembly-line procedure. Immediately following the excavation and pile driving, the concrete subbase and the underdrain system were installed and the wall base concrete was placed. The piers were cast on the base, and the arches built between the piers to form the cells, which were then capped.

Each operation was done as a series of relatively small units that could be easily connected with each succeeding operation following a regular sequence. Reinforcing used in the wall base was continuous and bulkheads were required between concrete pours, but the piers, the struts between piers, and the arches between piers were all cast as units. Reinforcing steel for each of these parts was assembled on the ground and set in place with a crane as a unit.

Forms for each unit were moved with a crane and used over and over. Each pier was cast in one continuous pour between forms that required only a few through ties. Each circular arched wall unit was cast in one continuous pour between steel forms that required no through wall ties. Separately handled inside and outside steel forms were bolted to Superior screw anchors cast in the faces of the piers.

The roof slab, 8½ in. thick, is supported on 225 columns of 20-in. diameter and 30 ft in height including the top and bottom drop heads. The columns were formed by two methods—sheet-metal forms and Sonotubes. In cost the two methods were comparable but the Sonotubes gave a much nicer looking finished column. The columns were poured in two lifts with a 30-minute wait between pours.

Forms for the roof slab were built similar to a drop-leaf table. The main body of the form was supported on steel-pipe scaffolding towers with a drop leaf extending out on each side to form the area between the columns and the drop heads. The slab forms were supported on 14 groups of towers with 7 towers in each group.

Construction was carried out by setting up 6 groups of towers and pouring an area 48 ft by 50 ft. Enough towers were fabricated to support one fifth of the slab so that the contractor used the forms five times.

After the slab was poured and the concrete had reached the specified strength, the towers were lowered and the wings dropped. Then each group of 7 towers was pulled forward into its next position. Here the towers were raised, the drop panels brought up into position, and the cycle of operation carried through to completion. The scaffolding was manufactured by Patent Scaffold.

Experience in building this basin, as well as the comments of contractors, led to the conclusion that this type of construction has a definite price advantage over the conventional cantilever wall of either the straight stem or counterforted type for heights of more than 20 ft. The sanitary features of this clear-water basin have been enthusiastically approved by the Bureau of Public Health Engineering of Missouri.

The structural design was checked by A. A. Brielmaier, F. ASCE, Professor of Structural Engineering at Washington University. This rather unusual clear-water basin design was developed by the St. Louis Water Division to serve a particular need. It is expected to serve its purpose well.

SMOOTHER BRIDGE APPROACHES

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Surface irregularities at ends of bridges, a highly undesirable feature on some highways, reduce driver comfort and safety and adversely affect the durability of roads and structures. Furthermore, where traffic is heavy, surface patching may be hazardous. Continuing settlement of approaches, which requires repeated maintenance patching, is particularly undesirable.

Recently bridge approaches on four freeways in the Los Angeles area were investigated. The area studied is in part an alluvial plain some 30 miles in width between granitic mountains on the north and the ocean on the south. Roads cutting across this area in various directions were selected for study in the hope of finding a relationship between the bridge approach irregularities and soil types.

Most of the bridges examined had concrete decks with concrete approaches, and most had concrete aprons about 12 ft long resting on paving notches. The general requirement for approach fills was a 90-percent relative compaction except for the upper 2 ft, where it was 95 percent. For the usual highway separation structure, approach fills averaged 20 ft in height and about 200 ft in base width. In the case of railroad grade-separation overpasses, approach fills were about 30 ft in height.

It was found that on the San Bernardino Freeway, much of which lies in coarse granular material, there was no approach patching at the ends of bridges. On the Santa Ana Freeway, which is further removed from the mountains, the material changes from granular to cohesive as one proceeds from Los Angeles to and through Orange County. On this road, 20 percent of the structures examined had approach patching at one or both ends. On the Hollywood Freeway, which crosses rolling terrain, there are quite a few clay-filled depressions. On this road 60 percent of the structures examined had patched approaches. On the Harbor Freeway, which extends toward the ocean and passes through areas of silt and soft clay, 70 percent of the structures examined had approach patching.

Contrary to expectations, little difference was found in the amount of approach surface patching for structures on piles as compared with those on spread footings. Forty percent of the structures on piles and 38 percent of those on spread footings had approach patching. Except in rare instances, differential settlement at the ends of bridges did not exceed 6 in. In the majority of cases a single patch job took care of the situation for a period of years but in some cases frequent patching had been needed to maintain a smooth road.

Although some settlement was often noted during the first year, approach patching generally was not needed until two or three years after the road was opened to traffic. In a few cases it had been necessary to patch before the road was opened to traffic.

Open-end versus closed abutments

The investigation revealed that more approach patching was required for closed-abutment bridges than for open-end structures. In the case of open-end bridges, the approach fills are usually completed before the bridges are built. During the construction of the bridge, there is time for the underlying ground to become consolidated by the weight of the completed approach fill. Also, grading and road compacting equipment may be employed to secure good compaction of the fill.

In the case of closed-abutment bridges, the approach fills are completed after the completion of the bridge and its abutments. To keep within specified time limits and to get the road open to traffic as quickly as possible, approach pavements are usually laid soon after the approach grading is completed. This allows little time for consolidation of the underlying strata on which the fill rests. Furthermore, good compaction of fill requires special equipment, time, effort, money, careful inspection, and frequently im-

ported fill. Poor workmanship may not show up until months after the contract is completed.

Some surface irregularities on bridge approaches are built in; others develop. An irregularity is built in when the approach pavement as constructed does not smoothly fit the bridge deck. An irregularity develops when a smooth road becomes rough with the passage of time.

As-built bridge profiles often differ from plan profiles because of inaccuracies in construction or settlement caused by construction of the approach fills. The engineer who assumes that plan grades are always correct and that benchmarks do not vary, and who builds approach pavements without carefully checking bridge deck elevations and making the necessary adjustments is likely to have trouble, as illustrated in Fig. 1. Where the highway alignment is fairly straight and there are no warped surfaces, and where the bridge deck does not deviate much from the plan grade, this adjustment is simple. However there are cases where it is not simple, and engineering office work is needed to make the grades fit so as to secure a smooth-riding road.

Ends of bridges sometimes settle when approach fills are constructed. Benchmarks sometimes change in elevation during the construction of a road project. To get a smooth connection between the bridge and its approach, adjustments are generally needed.

The surface irregularities that develop at the ends of bridges are caused by differential settlement between the bridge and the approach. The approach settlement may be due in part to the settlement of the ground beneath the approach fill and in part to consolidation of the fill itself.

Among the measures that may prove useful in reducing surface irregularities on bridge approaches are the following, here listed in order of increasing cost:

1. Use of open-end construction rather than a closed-abutment type, particularly where the underlying soil is poor.
2. Specifying early construction of approach fills at the ends of the bridge in order to allow as much time as possible for consolidation before the approaches are paved.
3. Use of good backfill material such as sand, gravel, or crushed rock, with a high shear value.
4. In the case of asphaltic roads, extending the asphalt surfacing across the bridge deck.
5. Surcharging the approach fills.
6. Making the approach apron slab about 30 ft in length to eliminate sudden grade breaks by bridging depressions near the ends of the bridge.
7. Removing poor underlying material near the ends of the bridge and replacing it with good material before fill is constructed.
8. Lengthening the bridge to reduce the height of the approach fills.

Typical cases

Poor natural material. In some cases the removal of a considerable depth of poor (compressible) material may be necessary, as shown in Fig. 2. The material removed may be in the form of a wedge, deeper at the bridge end, as shown in Fig. 3.

The cost of removing poor material and replacing it with more suitable fill varies with the depth of material removed. Generally the removal of material to a depth of more than 5 ft is not economical.

If the compressible material is soft, cohesive and clayey in nature and so thick that its removal would not be

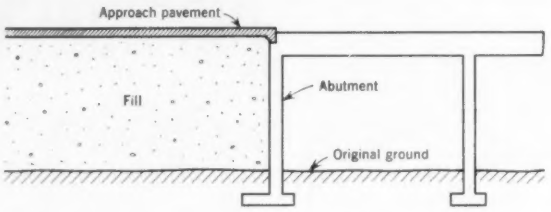

FIG. 1. Some surface irregularities at the ends of bridges are built in, as here illustrated. This approach pavement was laid to plan grade rather than to actual bridge grade. This type of irregularity can be avoided by running a profile grade across the bridge deck after the approach fill has settled and then adjusting grades.

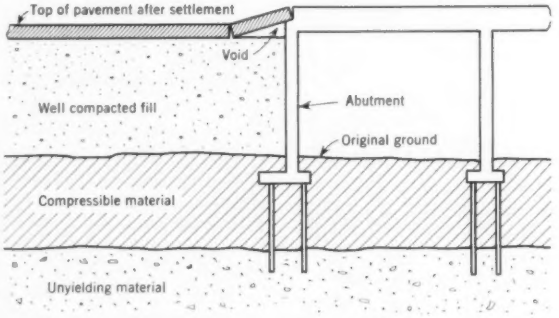

FIG. 2. A well compacted fill resting on a bed of compressible material may result in a differential settlement. The abrupt differential settlement at the end of this bridge could have been avoided by removing the compressible material or by consolidating it before the approach pavement was placed.

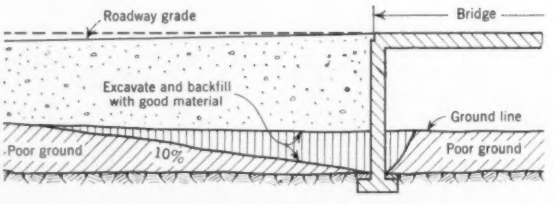

FIG. 3. Abrupt differential settlement near the end of a bridge can often be prevented by removing a wedge of compressible material before the approach fill is placed.

economical, the fill can be built and surcharged, and approach paving delayed until settlement readings show a slow rate of settlement. If, because of low permeability and considerable thickness of the compressible material, settlement is likely to continue for many years, the building of a fairly long reinforced concrete apron may be advisable.

If the compressible material is dry, very loose and granular, dyking and flooding may help to compact it. Ordinarily however, granular materials consolidate quickly during the construction of the fill. Truck and earthquake vibrations may cause further consolidation of granular materials.

Poor approach fill. Silty clays and wet materials of low permeability and material of low shear strength are generally unsuitable for backfill, as shown in Fig. 4. Good backfill is required for highway bridge abutments if irregularities in the road surface are to be avoided. A combination of sand, gravel and rock makes excellent backfill.

It is not always sufficient to specify good backfill methods. The poorer the material, the more necessary it is to watch placing and compaction. On large projects, where many important activities are proceeding simultaneously, this may present a difficult problem at times.

Backfilling around counterfort walls and abutments frequently requires tamping. Proper compaction is often an expensive chore which may be slighted. With good granular material, a judicious use of water is sometimes helpful, but care must be exercised in the use of water to avoid excessive lateral pressures which can cause walls to slide or rotate.

The chances of getting a good backfill job tend to increase with the quality of the backfill material that is specified.

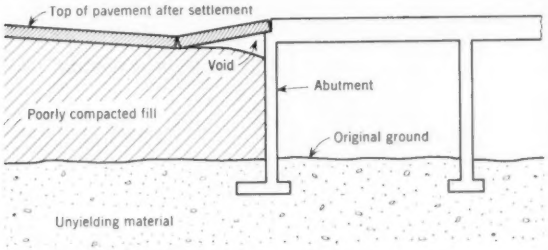

FIG. 4. An approach sag has resulted from a poorly compacted fill. The obvious way to avoid this situation is to construct a good approach fill using suitable material, properly placed and compacted.

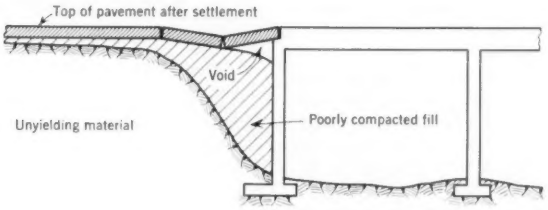

FIG. 5. An approach depression has resulted from the construction of a short, poorly compacted fill between a bridge and a steep, rocky bank. To avoid this situation, eliminate the approach fill by lengthening the bridge, or reduce settlement by using high-quality backfill or by flattening the rock slope.

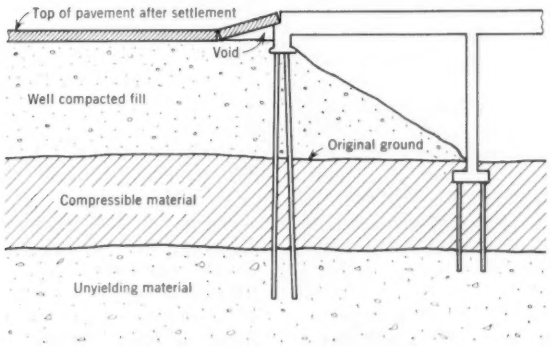

FIG. 6. Differential settlement at the end of an open-end span may be reduced by surcharging the approach fill, particularly if the underlying stratum is cohesive.

A steep, rocky bank. A depression in the approach results when a short, poorly compacted fill is constructed between the end of the bridge and a steep rocky bank. (See Fig. 5.) To correct this situation, one of the following alternatives can be used:

1. The approach fill can be eliminated by increasing the length of the end span and placing the abutment near the top of the rock slope.
2. The settlement can be reduced by using backfill material that is of high quality.
3. The rock slope can be flattened so that the change in depth of fill will be more gradual.
4. Open-end bridge construction can be used and a span added.
5. A long reinforced-concrete apron can be employed to bridge the fill.

Differential settlement. Differential settlement at the end of an open-end bridge span is shown in Fig. 6. The fill is well compacted and rests on a stratum of compressible material. If the underlying stratum is cohesive, surcharging of the approach fill may be effective.

If the compressible material is not thick, it can be removed and replaced with good material.

It is well to complete the approach fill early so that there will be as much time as possible for the consolidation of the compressible material.

Construction of the approach pavement should be delayed until the settlement platforms indicate that the settlement is essentially complete.

If approach settlement observations show that settlement has stopped, it may be sufficient in some cases to use a simple end span resting on an abutment without piles.

The early American engineer—

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The development of American civil engineering, like much else in the country's history, shows how easy it is to lose sight of plain things that men of an earlier period knew about their own lives. Recently enough, to take one example, Americans talked about morality and government in early New England, but without giving serious attention to the theology that the New England Puritans kept at the center of their culture. Or again, popular historians long seemed to write about the period after the American Revolution as if the Founding Fathers worked out a government in terms of the purest political theory; but the Fathers themselves did not separate theory from men's passions and practical interests. It is the same with the development of the civil engineering profession in the United States.

What is usually seen in the early American engineers—those before, say, the organizing of the American Society of Civil Engineers—are the technical tasks they accomplished. What we see is the design and execution of the Erie Canal by men who had no previous experience with public works of that scope; the solution of problem after problem in the construction of railroads; the evolution of ever more sophisticated kinds of bridge design. But the early engineer is rarely seen as an economic agent or executive. This is certainly not because more recent engineers are supposed to be pure professional technologists; rather, their importance for economic decisions and their fitness to serve in managerial posts not strictly technical are widely recognized.

Convention seems to assume that earlier Americans sought the services of civil engineers for strictly technical reasons, and that engineers went into ownership or management as a kind of promotion out of technical work. Certainly a need for technical competence is the only ultimate reason people would retain an engineer as such. Yet consider several examples of the way in which Americans first decided to seek the services of civil engineers.

In the eighteenth century, Americans had regular ways of providing for certain tasks that later generations would assign to civil engineers. A town or county that wanted to build a bridge or open a road organized a board of commissioners who then made the necessary arrangements with workmen and contractors. This board consisted of local men, some of whom would probably know enough about surveying and domestic building to cope with any of the simple technical problems that these projects posed. Even when private proprietors were the agency for building a turnpike or bridge, they usually administered their affairs on much the same plan as did local road commissioners.

Only for the exceptional project, such as a water-supply system or a long bridge or a difficult river improvement, did Americans call in a special technical executive from outside the circle of men personally concerned in the project. They then called in someone like Christopher Colles, an engineer-promoter from Ireland who often presented himself as ready to construct a canal or waterworks but who rarely got anyone to sponsor his projects, or like James Rumsey, the inventor whom George Washington retained as a makeshift engineer for the Potomac Company. In truly difficult cases they imported a foreigner like the English engineer William Weston. The Colleses and Rumseys and Westons were a miscellaneous lot, with no common background of training, and with little assurance of regular employment. They did not constitute a distinct professional group.

A definite type appears

The first signs of a definite type appeared in New York State in the 1790's, when the Western and Northern Inland Lock Navigation Companies were building several small canals or river-improvement works to connect the basin of the St. Lawrence with that of the Hudson and Mohawk. The president of the Companies was General Philip Schuyler, who as a landowner was deeply interested in the development of upstate New York, and who as an intellectually active gentleman had observed the usefulness of canals in Great Britain.

At first Schuyler and the Companies behaved like an ordinary oversized river-improvement organization. They tried the technical services of a variety of men who were supposed to have some experience or skill in such works. First there was Archibald Nisbet, who came from Scotland and was represented as "an able Artist, a compleat Engineer and Millwright." Under pointed questions from Schuyler, Nisbet denied having represented himself as an engineer and retreated to the status of millwright and contractor. Even when hired as a practical builder of wooden canal locks, Nisbet did not work out to Schuyler's satisfaction.

The Companies then retained one

two men in one

General Philip Schuyler acted as "Superintendent" on construction of the earliest canals and locks in New York State. From the New York Public Library.

Frederick de Zeng, who was a kind of general manager, and James McCotter, an immigrant millwright and contractor whose occupational status seems to have been much like Nisbet's. Neither of these men answered the whole need of the Companies, which were building some of the most ambitious canals yet undertaken in the United States.

Schuyler began corresponding with William Weston, who was then working on a group of canals in Pennsylvania. At that time, early in 1793, Weston was not free, and Schuyler took the drastic step of himself assuming the post of superintendent to the Companies. He insisted from the beginning that the Companies should not expect him to be technically competent, and he recommended an administrative system to deal with construction problems. He proposed that the Companies hire a full-time surveyor for the working season and that they hire trustworthy assistants to serve between the superintendent and the overseers or foremen. The choice of assistants seemed basically a social problem. "On the overseers who have been employed to engage mechanics and labourers, not much reliance can be placed, they will in general not be of sufficient respectability, to enforce that subordination, order, and industry—which is requisite in so extensive a business."

In other words, when Schuyler sought a substitute for the engineer he could not obtain, he found it in a threefold organization: himself as general executive, a surveyor to perform unavoidable technical tasks, and a group of assistants to control the labor force.

This arrangement did not provide all the technical skills required by the Companies, which finally hired Weston in 1795, but it does suggest that eighteenth-century Americans thought of the civil engineer as having a double capacity—he was a technical expert, to be sure, but also an executive or a bureaucratic inspector serving the economic interests of his employer.

Staffing the Erie Canal

The administrative meaning of the Western and Northern Inland Lock Navigation became clearer in the construction of the Erie Canal, which was the actual and legal successor to the Lock Navigation Companies. The Erie was also their successor in its policies on recruiting engineers. At one point the canal commissioners tried to obtain the same William Weston who had worked for the Companies. At times some of the commissioners took on engineering tasks themselves. But the first real solution the commissioners found to the problem of engineer-recruiting came from their finding a miscellany of persons who could be transformed into engineers.

Some among this group were chosen for their technical skills, as were the surveyor Isaac Briggs and presumably the Frenchman Louis Garin. These men, however, worked on the canal only a short time. More typical were several new "engineers" who combined a modicum of technical talent or experience with a strong interest in local land values and politics. Two were local justices—Benjamin Wright and James Geddes, M. ASCE. Wright had also worked earlier as an assistant to Weston and as a surveyor for the Inland Lock Navigation Companies. In a way, these men combined some of the attributes of Weston and Schuyler.

This first group of engineers on the canal still had little in common except their origin as enterprising gentry. They were an *ad hoc* solution to the problem of finding minimally competent men who would have some interest in the success of the project. More significant was a system the canal commissioners soon established for training young men as engineers. Just as Schuyler and the Lock Navigation Companies had had to retain a surveyor and inspectorial assistants, so too did Wright, Geddes, and the canal commissioners have to retain subordinates. They hired some surveyors, but only occasionally, and these led to no administrative innovation.

Then an inspectorial need developed

during 1817 and 1818. The canal commissioners declared that contracting presented "great opportunities for deception," and that, "to prevent this, the engineers were instructed to examine the works as often as their other avocations would permit; and also to employ faithful, active and vigilant assistants, who were frequently to traverse the line, and carefully to inspect every job, and commit to writing, and report to the engineer, every departure from a rigid compliance with the respective contracts."

Some of these assistants "manifested a praiseworthy zeal to qualify themselves as engineers," and by the end of 1818 that zeal was beginning to be satisfied. "The whole line," the commissioners reported, "has been subdivided into five parts, to each of which has been assigned an intelligent, active and vigilant overseer, or assistant engineer, who had previously learnt the use of the leveling instrument; an accurate method of designating the dimensions of the canal, upon every variety of surface; the general principles necessary to ensure the best construction; and the nature of the stipulations contained in the several contracts."

One of these assistants, Canvass White, went to Europe in 1817 "with a view to making himself fully acquainted with the best mode of constructing all the works appertaining to Canals." By 1822 he and two of his fellows rose to the rank of principal engineer. By 1825, when the Erie was finished, most of its principal engineers had worked up from subordinate, typically inspectorial posts within the system.

Many of these men had begun even lower in the canal hierarchy, as chainmen or rodmen in surveying parties. In any case, some of them later became major figures in American engineering, on other projects as well as on the canal. The most important of them was one who did not reach the rank of principal engineer by 1825: John B. Jervis, later a member and Fellow of ASCE, who directed construction of such works as the Delaware and Hudson Railroad and the Croton Aqueduct.

Jervis, White, and the others whom the Erie Canal produced, were men of technical competence, even great competence. But in origin they were more than that. If the Erie Canal commissioners had not had to solve the specific organizational problem of establishing an inspectorship over contractors on behalf of the state, recruiting of engineers would not then have reached either the scale or the form that it did.

As is a commonplace in the history of American engineering, the New York State canals furnished the pattern and the personnel for much of the transportation construction of the early nineteenth century. And it was not just the technical achievements of the Erie Canal that men imitated on other projects; they also followed the New York model in organizing bodies of engineers and in training new engineers within these corps.

Early engineering schools

There were, of course, other ways in which men became engineers, even during the early years of that century. A few engineers, such as the elder Benjamin Henry Latrobe and the younger Loammi Baldwin, took office apprentices in much the same way as did physicians and lawyers. More important, there were some schools that gave formal instruction in civil engineering; of these the earliest were West Point, Alden Partridge's Academy (later Norwich University), and Rensselaer.

In later years these and other schools trained an increasingly large proportion of American engineers, but this was not true until after the civil engineer had been established as a professional type. Only West Point and the Army Engineers provided a real alternative to the Erie Canal model in the years when the profession was in the process of getting established. In the late 1830's, when relatively more Army Engineers were working as civil (and civilian) engineers than at any time before or since, they made up something like a fourth or a third of the leading engineers in the country.

But to many Americans of the early nineteenth century, to people who took seriously all the rhetoric of Jacksonian democracy, the Army Engineer represented a "high-toned" professionalism that reeked of monopoly and aristocracy. In 1828 and 1829, when the Baltimore and Ohio Railroad was laying its first miles of track, it had an engineer department headed by a committee, not by a single chief engineer. The main engineers on this committee were two men on loan from the army, Lt. Col. Stephen H. Long and Capt. William Gibbs McNeill, plus the civilian Jonathan Knight, whose background in road-building and state politics made him of a type with Benjamin Wright of the Erie Canal.

A problem of accounting

A bitter quarrel arose between the two kinds of engineers working for the B. & O., and also between the Army Engineers and the company management. To maintain good relations with a public that was still skeptical of railroads, the company had to push construction rapidly, and it was willing to tolerate lax accounting for contracts. Long and McNeill, who brought from their army work a sense of strict, even bureaucratic propriety, objected to letting subordinates spend large sums of which the company never received any detailed record. Long, who was one of the more competent bridge designers of that generation, found himself excluded from the planning of large bridges for the railroad; this task the company gave to "practical" builders and contractors.

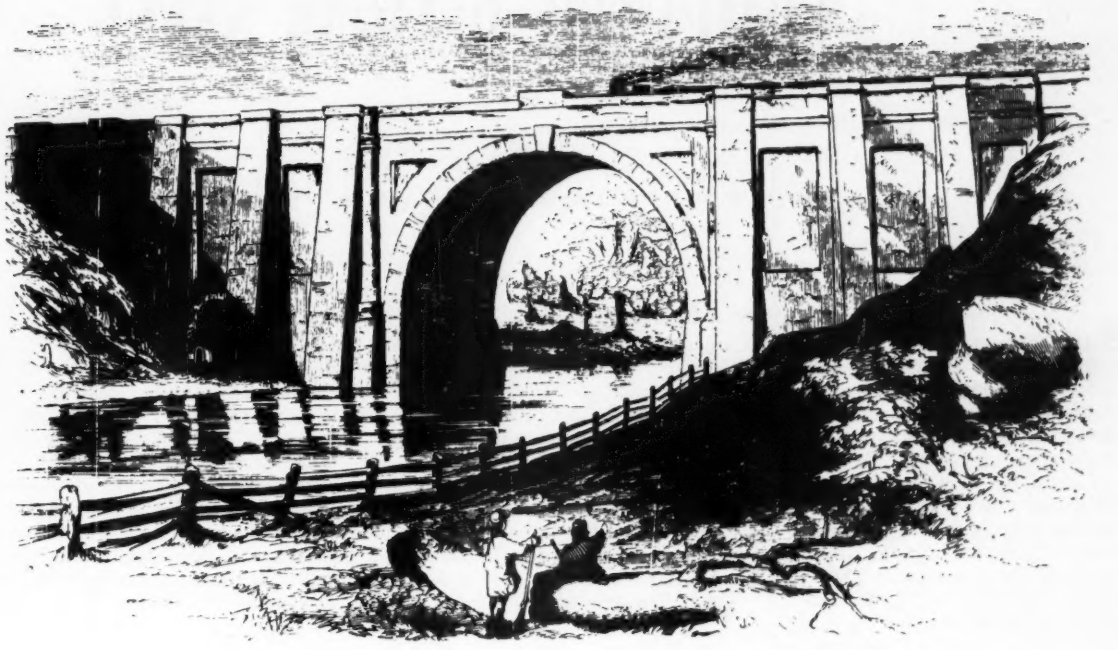
Both Long and McNeill found that overseers evaded instructions from them, the engineers; and they suspected that the president and directors connived at this evasion. The company, at the same time, considered the army standards a "rigid formality" that "might be dispensed with." When Long and McNeill pressed charges before the directors against the company officer they thought most culpable, the company discharged the two army men and made Jonathan Knight its single chief engineer. Over the 1830's, the company developed its own engineer corps, organized in the same way as engineer departments on other works; and in 1842 Benjamin Henry Latrobe the younger, who had been trained in that corps, became chief engineer.

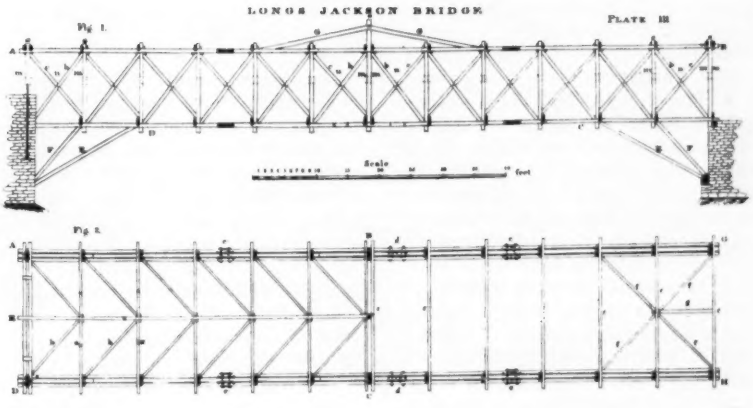
Colonel Long and Captain McNeill had in the meantime worked for other railroads where they had encountered problems of defining their status as engineers—Long for the Western and Atlantic Railroad of the State of Georgia, McNeill for a group of railroads in New England. On these roads their abilities, combined with the scarcity of engineers and a less panicky management than had characterized the B. & O., won them approximately the status they expected. Even so, both had to act cautiously; and McNeill met in New England a strong feeling that Army Engineers were trying to monopolize the civil engineering profession. The rigid professionalism that he and Long represented got a cool reception in their generation.

Much expected of engineers

But if Americans then looked suspiciously on engineers who presented themselves as strictly professional, just what did they expect of civil engineers, during this period when the civil engineer was getting established? Long and McNeill, after all, defended precisely that need for inspection and accountability that had seemed so important on the Inland Lock Navigation and on the Erie Canal.

The answer seems to be this: society, and in particular the employers of engineers, expected all along not only that the engineer would act as a professional, as a technological expert, but





Wood-frame design prepared by Col. Stephen H. Long for bridges carrying B. & O. trains (right) is contrasted with one of the conservative structures adopted instead, the Carrollton Viaduct near Baltimore, built about 1829 (above). Sketch at right is from Long's 1830 pamphlet, "Description of the Jackson Bridge"; view above from "Ballou's Pictorial Drawing-Room Companion," March 10, 1855.

also that he would work well in the business life of the organization that retained him. As sometimes happened in the early life of an American railroad, the B. & O. had urgent needs that hardly fitted any standard of meticulous accounting. Typically, however, private companies and government public works departments of that period saw the value of economy.

When an organization hired engineers, it expected them to protect it in any conflict of interest with contractors. At the same time, it sometimes also expected engineers to be promoters, either as political partisans if the organization was a government, or as economic promoters if it was private.

All this is what would be expected by analogy with the twentieth-century engineer. The engineer sometimes becomes a salesman, as is to be expected in a vigorous competitive economy. The engineer is sometimes a promoter, as in such an economy he must and should be. Among engineers there is wide variation as to the degree of independence they find in their work. Some are consultants, and fit the strictest definition of professionalism. Some are entrepreneurs or work in general management. Many are more specialized members of some organization and, however responsible their work, must act within the policy needs of that organization. All this is normal in a complex society.

But the general outlines of this picture are not peculiar to the intensely complex society of the present century. The American civil engineer has always had a dual character, economic as well as technological, and he has had to adapt himself to a variety of economic situations. Earlier Americans recognized this duality in their own period. Modern Americans recognize it in theirs; but they also may find the reassurance that men usually get from realizing that their pattern of living derives from a substantial past.

(This article is based on Mr. Calhoun's book, "The American Civil Engineer: Origins and Conflict," forthcoming from The Technology Press, M.I.T. Permission to reuse should be obtained from the author.)

COMPUTER DESIGNS STEEL . . .

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Steel for an entire floor can now be designed in one continuous operation instead of piece by piece as was formerly necessary. This new design procedure has been made possible through the use of electronic computers.

Part of the AISC Specification for the design of structural steel for buildings has recently been developed into a series of programs for the IBM 650 electronic digital computer. These programs, recorded on 1,000 punched cards, direct the computer as it processes loading data and performs the arithmetical and logical operations necessary for the selection of beams and columns of minimum weight to comply with the AISC code for the design of simple framing.

At first thought there would not appear to be any advantage in using an electronic computer to design simple beams and columns. The calculations are elementary, and for many members in regular buildings no calculations at all are necessary since the sizes can be obtained from tables. However, as those who have done the work well know, buildings are seldom entirely regular, and a considerable amount of calculation is nearly always required. For large, irregular, heavily loaded buildings, such as steam-electric power-plant structures, practically every piece must be individually designed. This in itself would not make the use of a computer advantageous, that is, if it were necessary to enter the loading data for each piece separately, requiring the computer to design each beam as if it were an independent member. The thing that makes the computer practical is the concept of entering the loading data for a floor at a time rather than for a piece at a time, so that the machine can design the steel for an entire floor in one continuous operation.

To utilize the computer to best advantage, the loading data for all the beams in the building must be recorded before any calculations are made. The recording is done by structural designers working from loading diagrams and preliminary framing plans. A system of numbering for the beams and columns, as shown in Fig. 1, tells the computer the geometrical configuration of the framing. The piece numbers, beam loads and dimensions are written by the designers on printed forms specially arranged for the convenience of key punch operators, who transfer the data to standard IBM cards. The accompanying "Flow Chart" shows the sequence of operations, including the printed forms and the data and design cards. The data cards ("A" cards) are grouped by floors, and the cards for each floor are arranged in proper sequence so that the beam reactions will be carried forward as loads on the girders into which the beams are framed.

The computer, under the guidance of its internally stored program, will remember the reactions of the beams it has already designed, and recover the reactions from storage when they are required as girder loads. Since the reactions must be stored, the number of beams in any one floor cannot exceed 500. On the average it takes two "A" cards per beam to enter the dimensional and loading data. Duplicate cards are made for duplicate pieces so as to obtain the advantage of having in the file one card for each piece of steel.

Before the computer can commence processing the "A" card data, the program deck of cards, containing the 700 machine instructions, plus the design properties of 144 rolled-beam sections and 28 channel sections, is read into the computer. This operation takes two or three minutes. The computer is now ready to start work. It will read and process the entire deck of "A" cards automatically. It calculates the maximum moment in each beam, and selects from its internally stored tables the lightest section with the required section modulus. It then revises the moment for the weight of the beam section first selected, and makes an approximate check of deflections in accordance with Section 17 ("Depth Ratio") of the AISC code. Next it modifies the allowable stress if required by considerations of lateral stability. The computer returns to the tables to pick up the next section as many times as necessary, until a section is found that satisfies all the requirements. The computer output is in punched-card form, one card per beam ("B" cards). Each "B" card contains piece identification, designation of section selected, and values of reactions, moment, and section modulus required.

After the beams have been designed, the next step is to assemble the column loads. A program has been written so that the IBM 650 can do this, using the "B" cards as the source of input data. This step can be done immediately upon completion of the beam design. Because of storage limitations it is not usually possible to take off all the column loads for a building in one pass through the computer, and the deck of "B" cards must be read several times. The computer can handle up to five 30-story, or ten 15-story columns at one pass. Splice locations are assigned by the designer. The output of the beam-to-column design program is again in punched-card form, the "C" cards, suitable for immediate use in a column design program.

The next, and at present the final step in the design operation, is the selection of column sections. Again a table of the design properties of the rolled sections and cover-plated rolled sections usually used for columns, and taken from the AISC manual, is read into the computer. A third program of machine instructions enables the computer to select the lightest column that will comply with the requirements of the AISC code. The output of this program is a deck of "D" cards, two per column per story. These cards contain the designation of the section selected, the values of load and moment, and the function,

$$r = \frac{f_a}{F_a} + \left(\frac{f_b}{F_b}\right)_{xx} + \left(\frac{f_b}{F_b}\right)_{yy} \text{ for}$$

the top and bottom of each story. The terms xx and yy are used to identify the axes of the column sections. According to Section 12 ("Combined

. . . a floor at a time

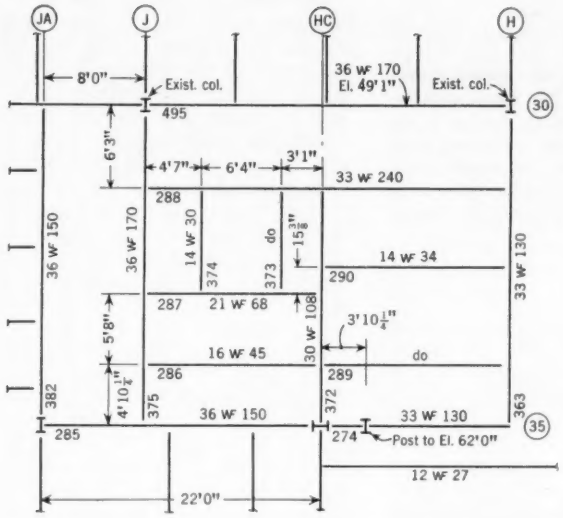
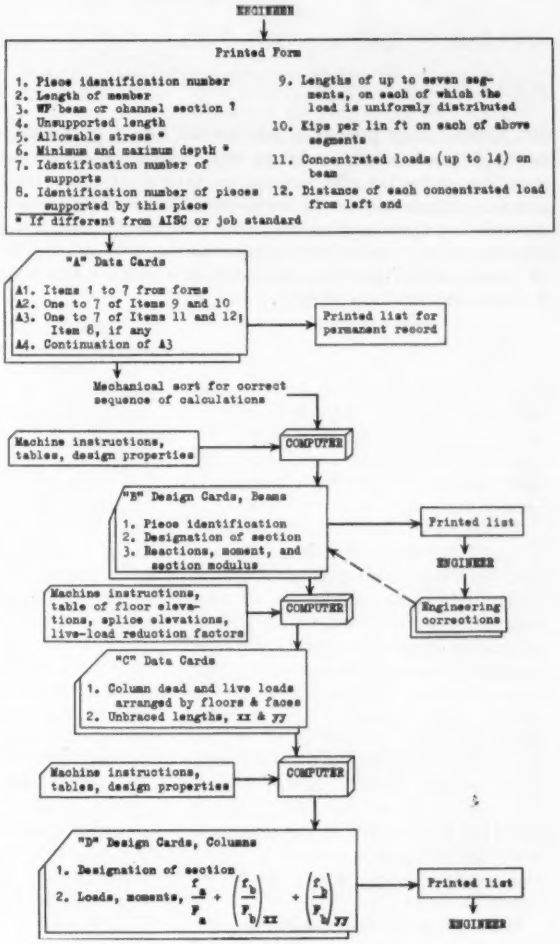


FIG. 1. A system of numbering for beams and columns tells the computer the geometrical configuration of the framing. Shown here is a plan view of structural steel at El. 50 for a building designed with the aid of a computer. Each member is numbered in conformity with the IBM listing.



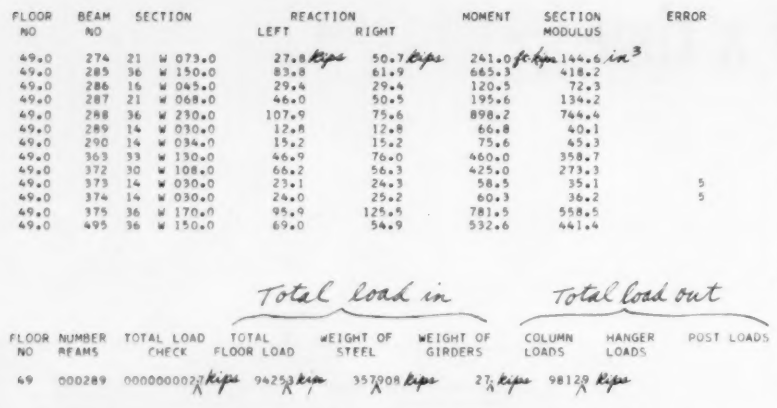
FLOW CHART, at right, indicates steps by which steel for an entire floor is designed by computer in one continuous operation. Before the computer can start processing the "A" data cards, the program deck of cards, containing the 700 machine instructions, plus the design properties of the 144 rolled-beam sections and the 28 channel sections, is read into it.

Stresses") of the AISC code, r must not exceed unity, so the computer analyzes every entry in a table of column sections, arranged in order of weight, until this criterion is satisfied.

The three programs just described can be run consecutively. A small amount of card manipulation, sorting, and insertion of previously prepared cards is required between passes through the computer, but no intermediate key-punching or calculations are needed. The speed at which the work progresses depends somewhat upon the complexity of the framing. The computer will select beams under uniform loading at the rate of about 40 per minute. The average rate, for powerhouse framing, is about 11 beams per minute.

The second program, which calculates loads and unbraced lengths for the columns, proceeds at a rate determined by the speed at which the computer reads the cards containing the beam reactions. An average rate for this program might be a minute per column.

The third program, which selects the column sections, is not, in its present stage of refinement, impressively fast in operation. The computer takes at least 2½ minutes to get through a 15-story column, and it may take as long as 15 or 20 minutes in exceptional cases. Experience to date has indicated that the average for a typical powerhouse might be 5 minutes per column. Putting all these times together, it will be seen that a steel frame consisting of 2,000 beams and 80 columns, and weighing, say, 2,500 tons, might be expected to



FLOOR NO	BEAM NO	SECTION	REACTION LEFT	REACTION RIGHT	MOMENT	SECTION MODULUS	ERROR
49.0	274	21 W 073.0	27.8 kips	50.7 kips	241.0 ft-kips	144.6 in³	
49.0	285	36 W 150.0	83.8	61.9	665.3	418.2	
49.0	286	16 W 045.0	29.4	29.4	120.5	72.3	
49.0	287	21 W 068.0	46.0	50.5	195.6	134.2	
49.0	288	36 W 230.0	107.9	75.6	898.2	744.4	
49.0	289	14 W 030.0	12.8	12.8	66.8	40.1	
49.0	290	14 W 034.0	15.2	15.2	75.6	45.3	
49.0	363	33 W 130.0	46.9	76.0	460.0	358.7	
49.0	372	30 W 108.0	66.2	56.3	425.0	273.3	
49.0	373	14 W 030.0	23.1	24.3	58.5	35.1	5
49.0	374	14 W 030.0	24.0	25.2	60.3	36.2	5
49.0	375	36 W 170.0	95.9	125.9	781.5	558.5	
49.0	495	36 W 150.0	69.0	54.9	532.6	441.4	

Total load in — Total load out

FLOOR NO	NUMBER BEAMS	TOTAL LOAD CHECK	TOTAL FLOOR LOAD	WEIGHT OF STEEL	WEIGHT OF GIRDERS	COLUMN LOADS	HANGER LOADS	POST LOADS
49	000289	0000000027 kips	94253 kips	357008 kips	27 kips	98129 kips		

FIG. 2. This listing, printed by the IBM 650, covers the section of floor framing shown in Fig. 1. Hand written notations were added for clarification. The information on each line of the list also appears on individual cards. Included in the list is the summary information for the entire floor. This summary information comes out automatically on a card at the end of the floor calculations. The total load check is the absolute value of the difference between the "load in" and the "load out." The error "5" indicates that the calculated reaction is within 5 kips of the capacity of a Series A connection for these pieces.

require about 11 hours of IBM 650 computer time, as a minimum. Practically, such a job would probably require two 8-hour days of computer time after the input cards have been completely verified.

To a considerable extent the formulas of the AISC design specifications have been built into the computer programs, while at the same time provisions have been made in the format for input data to provide for modifications by the steel designer. The designer can change the basic allowable bending stress, or the limiting ratio of span length to beam depth, or both, for any or all beams. He can specify a minimum or maximum depth, or both, for any beam or column. The constants of the AISC column formulas are placed in the computer when the program is read in, but these too can be changed easily if the designer so elects.

Throughout all the calculations, provision is made for separate computations for dead and live loads, so that the live-load reduction formulas permitted by most building codes can be applied without difficulty. Such matters as the inclusion of beam moments and column loads due to the weight of the steel itself, and column moments due to loads applied to the column flanges, are of course taken care of automatically by the computer programs.

For the permanent record, the loads and dimensions for the individual pieces can be transferred from the "A" cards to printed forms by means of ordinary IBM accounting machines. This printing operation, known as "listing" in the language of the trade, is carried out at the rate of about 150 cards per minute. A typical list, with summary data, is shown in Fig. 2. The output data, in "B" cards and "D" cards, can be sorted and listed by floors or by type of section. Various summary cards are produced by the computer at appropriate times during the execution of the programs; these provide figures for the total load in the building, total weight of main steel framing, and other data useful in checking.

The programs themselves, together with the input and output data formats and the techniques that have been developed for card manipulation, constitute a design system. The entire system is liberally supplied with self-checking features, mainly based on the principle that the number of pieces and the total load coming out of an operation must be equal to what went in.

In a year of operation, all the mistakes that have been found in the output have been directly attributable to human error in preparing the input data. A supplementary program has recently been written, and is now being tested, which is expected to reduce the number of input errors by a method of checking the input cards for self-consistency.

It should not be inferred that "instant engineering" has been achieved. A careful review of the machine output must be made by competent engineers to make sure that the checks have been satisfied, and that the sections selected are satisfactory for headroom, clearances, erection and detailing, as well as for other considerations concerning which the computer is not able to exercise discrimination. To complete the job, the engineer must make designs, by conventional long-hand methods, for such items as turbine-room frames, trusses, stepped columns, spandrel beams, bracing and base plates. Also, at least for the present, the computer programs do not provide for the checking of wind stresses, the design of plate girders, or the computation of stresses in rolled sections used as beams subject to end moments, axial or transverse load, torsion, or other unusual loadings.

The time saved by the use of the computer in the design of simple steel framing is influenced greatly by the complexity of the framing itself and also by the previous practices of the user in making and checking design calculations. Experience has indicated that the beam input data sheets can be written in half the time it would take to make design calculations manually. If half as much time is allowed for checking the manual calculations as for making them, then it follows that the designer is through with the design of the floor framing in one third of the manual design time if he uses the computer. Column design and weight take-off are incorporated in the computer system without further effort on the part of the designer. The cost of the remaining part of the work, key-punching and machine rental, although not insignificant, tends to be small in comparison with the cost of the time of the engineering personnel ordinarily employed to make steel designs.

Direct savings as a result of using the computer are about 50 percent in man-hours, and 50 percent in calendar days, as compared with the time required to do manually the same work the computer does, namely, convert loads and dimensions into beam and column designs. Indirect savings, impossible to evaluate, accrue from the promptness with which the steel design can be given to mechanical and electrical engineers, architects, and foundation designers.

The first of the programs described here has been in productive use since December 1957, and others have been put to work as they became available. Experience with the computer operation has been gratifying, and it is the opinion of the users that most such work will eventually be done by computers.

All the coding, and much of the logical development of these programs was done by Shui Ho and Lloyd Lawrence, F. ASCE, engineers on the staff of Jackson & Moreland, Inc. Program listings have not yet been released for publication.

Poured-in-place 60-in. semi-elliptical sewer

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With a progressive look to the future, the City of Tulsa, Okla., voted a bond issue in 1955 for expansion and improvement of its sanitary sewers. A part of this expansion is the Mingo Creek trunk line to serve the entire Mingo Valley on the east side of Tulsa, an area about 8 miles long and 6 miles wide containing 31,000 acres. The sanitary sewer requirements for this area when fully developed would be equivalent to the needs of 400,000 people. Parts of the area are already developed and are served by three small treatment plants and three pumping stations. These facilities are to be taken out of service as soon as the new facilities are complete.

The sizes of all sewer lines in this comprehensive study were based on the assumption that the entire 31,000 acres would be fully developed, with an average sewage flow of 1,500 gal per acre per day. This is equivalent to 13 people per acre and 115 gal per capita per day.

This report will be confined to the lower two miles of the trunk line, which has to carry an average flow of 46.5 million gal per day. This would require a circular pipe of 60-in. diameter or an equivalent cross-sectional area, at a slope of 0.15 percent.

The consensus of opinion was that the city might realize a considerable saving if alternate bids were received on a semi-elliptical sewer that could be poured in place. A sewer with the cross-section of Fig. 1 was selected.

The hydraulic elements were calculated for this elliptical section with the results shown in Table I. Any flow depth of 6 in. or greater would have a self-cleaning velocity. The average depth of the initial flow in the trunk line will be greater than this.

As shown in Fig. 2, where the circular and semi-elliptical sections are compared, the circular section has the greatest discharge at maximum capacity. At any depth of flow less than about 78 percent of total, the semi-elliptical section has the greatest discharge. At average flow for the fully developed area, the depth of flow would be 36 in., which would be 60 percent of the total depth and 66⅔ percent of capacity.

The structural design was according to the "Analysis of Sewer Section" given in the Portland Cement Association's "Analysis of Arches, Rigid Frames and Sewer Section." The average depth of fill from the flow line was 22 ft, but a conservative depth of 25 ft of fill over the pipe was used in the analysis. The outside width of the pipe is 6 ft 6 in., so a trench width of 9 ft 0 in. was used in design and construction. This allowed 15 in. between the pipe and the wall of the trench, which is adequate for working space.

Longitudinal construction joints were placed as shown in Fig. 1 for ease of construction. Widely varying opinions were encountered in the spacing of

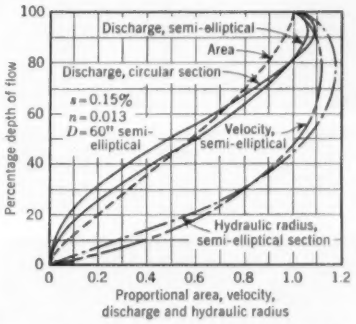

FIG. 2. Discharge capacities of circular and semi-elliptical pipe are compared.

FIG. 1. Semi-elliptical cross section was chosen for Tulsa, Okla., sewer. Note longitudinal construction joint on each side. Transverse joints were placed every 80 ft.

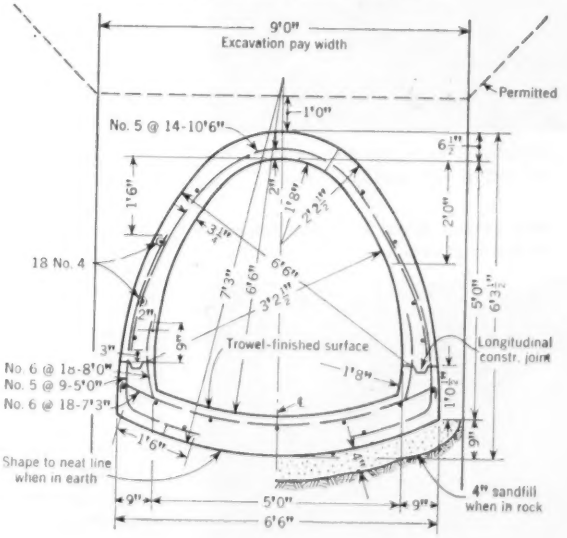

TABLE I. Calculated hydraulic elements of 60-in. semi-elliptical pipe

DEPTH, IN.	% FULL	AREA, SQ FT	p, FT	r, FT (a/p)	v, FPS	q, CFS (av)
60	100	19.58	16.29	1.20	5.25	103.0
3	5	0.60	3.62	0.166	1.07	0.64
6	10	1.68	5.00	0.336	2.1	3.53
12	20	4.14	6.02	0.688	3.45	14.28
24	40	9.09	8.03	1.131	4.8	43.7
36	60	13.65	10.11	1.349	5.7	77.8
42	70	15.66	11.22	1.395	5.75	90.0
48	80	17.40	12.39	1.407	5.8	101.0
54	90	18.80	13.68	1.375	5.75	108.2

Special jig ties floor steel in 40-ft sections, handled by crane with special lifting rack.

Floor and curbs have been poured. Note vertical banks extending to one foot above top of pipe.

Bulkhead is being set and waterstop positioned for one section of pipe.

After outside barrel form was set, concrete was placed with ¾-cu yd bucket.

transverse construction joints. Some believed a spacing of 30 or 40 ft apart was necessary, others that no such joints were necessary except for the construction joints at the end of a day's pour. Final design called for joints to be spaced every 80 ft, thus requiring daily pours to be of this length. Analysis showed this spacing to be adequate to take care of shrinkage and contraction. Water stops of natural rubber, 6 in. wide, positioned at the center of the section all the way around the barrel, were used at every transverse joint. None were used on longitudinal joints, where shrinkage and contraction were no problem.

Inside finish was to be equal to that of precast pipe. Any honeycomb or other defect was to be pointed with mortar and rubbed smooth immediately after removal of forms.

Average spacing of manholes was 500 ft, with a maximum of 625 ft. The manhole working chamber is 7 ft long, 8 ft wide and 8 ft high with a 4-ft-square opening for easy access.

For its entire 2-mile length, the sewer is in a shale formation varying from 3 to 8 ft above the flow line. The contractor was required to undercut this shale to a minimum of 4 in. below the bottom surface of the pipe. Bedding was provided up to the spring line. An option was allowed on bedding material. It could be either locally acquired sand, or limestone screenings available at local crusher plants. These limestone screenings, by-products of normal crusher operations, have a very limited use, but are excellent for this purpose. Their gradations were as follows:

Screen Size	% Passing
½ in.	100
No. 4	98
No. 10	72
No. 40	37
No. 80	24
No. 200	12

This densely graded material is equal to or better than sand for bedding. It is easy to handle, place and shape and has less tendency to wash away or to be displaced by loading due to the interlocking effect of the irregular shaped particles. Its in-place cost was from a quarter to a third that of in-place sand, resulting in considerable savings to the city.

The contractor obtained concrete from a commercial batching plant and hauled it to the job site by transit-mix trucks. There was a plant inspector to assure compliance with rigid specifications on gradation, proportioning, batching, mixing and transportation.

Durability and long life are of the utmost importance for a sewer. For this reason, a higher ratio of the larger aggregate was used to keep the water-cement ratio as low as possible. But with a relatively thin wall and heavy reinforcement it was necessary to use enough fines and a water-cement ratio that would give a workable mix. Design strength of the concrete was 3000 psi.

A set of three cylinders was taken from each day's pour, breaks to be made at 7 and 28 days with one extra cylinder to check an irregular break. Actual breaks averaged 2,800 psi at 7 days and 4,000 psi at 28 days.

Forms were fabricated from sheet steel, the outside being adjustable and the inside collapsible to facilitate moving ahead. Concrete was placed by crane with a ½-cu yd bucket and was compacted by internal vibrators. Floor and curb pours were kept from two to four days ahead of barrel pours. Extreme care was taken to make neat, smooth and well-formed keyways in the top of the curb and to see that these were clean before the barrel was poured. This was essential to prevent leakage along the longitudinal joint.

After the project was well under way, the contractor fabricated another 80 ft of forms and increased his progress to 160 ft per day. This required devising a means to hold the waterstop in place and form a keyway for the intermediate joint. In warm weather the contractor was allowed to pull forms after 24 hours. Proportionately longer periods were required in colder weather. At low temperatures protection and heat were required during the curing period.

Backfilling was not allowed until 14 days after pouring. When suitable, material from excavation was used for backfill around and over the barrel. Care was taken to place backfill in equal amounts on each side of the barrel, and approximately 2 ft over the top of it. The material was moved along with a dozer. Compaction was not required.

The City of Tulsa has a policy of flushing the backfilled area to check for infiltration. Since this trunkline parallels a creek and the flow line is about 6 ft below that of the creek, water covers the outside of the pipe, an ideal condition for checking infiltration. Throughout the length of the pipe, the amount of infiltration was negligible. Occasional spots of efflorescence appeared on the walls in places where water had found its way through minute openings. Leakage at these spots generally was only enough to make the surface moist and to leave a white flaky deposit of calcium carbonate. In the presence of moisture, concrete exudes calcium hydroxide, which is converted to calcium carbonate on exposure to the at-

mosphere. This seals the openings.

In connection with the joint spacing, some most interesting results and conclusions were noted. The first 15 sections (a section being 80 ft between joints), which amounted to 1,200 ft of pipe, formed intermediate cracks varying from a hairline to 1/16 in. in width. One section had four cracks, two sections had two cracks, and the other twelve had only one crack—generally near the center of the section. Some of these cracks had enough seepage to readily wet a finger, some had small seepage, and some had completely closed up, evidently as a result of autogenous healing.

A check of the inspector's daily report revealed that this 1,200-ft stretch was poured between Sept. 18 and Oct. 9, 1957. The maximum temperature varied from 80 to 89 deg F and the minimum varied from 48 to 60 deg F. After Oct. 9 the temperature maximum ran in the 60's and the minimum generally in the 50's.

The cracks that formed were caused by thermal contraction, notwithstanding the longitudinal reinforcing steel. In this first 1,200 ft, joint spacing should have been at 40-ft intervals to eliminate all cracking. As for the one section that has four cracks, the inspector's report showed not only that this section was poured on the hottest day, 89 deg, but also that this was the only section where the contractor made the pour in the morning, starting at 7:30 and finishing at 10:30 a.m. Thus the sun shone directly on the metal forms in the north-south open ditch during the hottest part of the day, and temperatures probably were higher than the 89-deg high would indicate. All other pours were completed in the afternoon when temperatures were lower.

After the pipe was backfilled, the temperature remained cool and constant. Thus the first 1,200 ft of pipe poured underwent the greatest temperature differential.

In conclusion, the overall results of using the poured-in-place semi-elliptical section are very gratifying. Its advantages exceed those of circular pipe in the desired working area. Infiltration, including that through the shrinkage cracks in the first 1,200 ft placed, was too small to obtain a measurable flow. Also the semi-elliptical pipe was considerably more economical than the circular pipe.

The overall cost for 11,350 ft of pipe was $536,000, or a little over $46 per lin ft. The major items were 80,000 cu yd of excavation and backfill at $2 per cu yd; 11,350 ft of 60-in. cast-in-place pipe at $25 per ft; and 21 manholes at $3,000 each.

The owner is the City of Tulsa, Utility Board, with Wm. F. McMurry, Superintendent of Water Works and Sewerage.

For the engineer, Wood & Craig and Owen, Mansur & Steele, Cline L. Mansur, F. ASCE, is Supervising Partner; Frank Kirk, Resident Engineer; and the writer, Designing Engineer.

The contractor was Southeastern, Inc., of Tulsa, Okla.

THE READERS WRITE

Mutual respect between public and private agencies needed

To THE EDITOR: The article in the April issue, "What Price Socialization of Engineering?" by Mr. Walsh, was a rather interesting presentation of his views with respect to the relationship of consulting engineering firms to public works engineering agencies, and as Mr. Walsh himself stated, the topic is certainly controversial.

While his viewpoint as a businessman should be respected, it must be pointed out that an article such as this tends to drive a wedge between engineers employed by public and private agencies. It is also damaging to the morale and professional pride of the public works engineer and thereby renders a definite disservice to our profession.

There are points made by Mr. Walsh which are well taken, but there are many others which could be successfully rebutted. However, to do so would require a letter of a length similar to the original article.

We in Philadelphia do not disagree in principle with Mr. Walsh's position that planning, programming and supervision are governmental functions. Many of our large engineering projects are designed by consulting firms as a matter of policy. However, there are many projects of small construction cost, yet important to the community, which in the interest of time and economy are designed by our own professional staff.

We further feel there is a place and a need for both the consulting engineer and the public works engineer and that the relationship between the two must be maintained on the highest professional plane. A prime requisite is that *both* the consultant and the public works agency be adequately staffed by competent professional engineers who intuitively subscribe to the code of ethics of our society.

The areas of responsibility of the consultant and the public works engineer are different, and it follows that the areas of skills are different. One party must assist the other in bringing about a complete and economical finished improvement.

The satisfaction to be derived from the successful completion of a multi-million-dollar project is great whether viewed from the vantage point of the consulting engineer or the public works engineer, but it is no greater than the satisfaction to be gained from the relationship between consultant and public works engineer when each views the other with a mutual confidence, respect, and personal regard. Such are our rewards when we approach our chosen field with a truly professional point of view.

NOEL W. WILLIS, M. ASCE

Chief Bridge Engr., Dept. of Streets, City of Philadelphia

Philadelphia, Pa.

Greater recognition in government employ

To THE EDITOR: As a civil engineer who has been employed both by a consulting firm and by a government agency, I wish to reply to the article "What Price Socialization of Engineering?" by Donald A. Walsh, in the April issue (p. 56). The views I express are strictly my own.

Professional recognition is something that all engineers are concerned with. Professional recognition and social advancement are not incompatible; in civil engineering they go hand in hand. Certainly professional recognition is given in a much greater degree to the engineer in government employ than to the engineer in industry or in a consultant's office. In many industrial and consulting offices engineering employees still punch a time clock, are paid by the hour, are docked for time off, must use their vacation time for sick leave, and must literally fight for a raise to keep their pay in line with their experience. And the routine ruts they get shoved into are many. If it were not for the more socially enlightened treatment given to civil engineers by state governments such as California, referred to in the article, or by the Federal Government, our professional status would be little more than a farce.

The basic aim of most "consulting"

firms is exactly the same as that of industry—to make a finished product that can be sold at a profit, in most cases contract plans. The salaries of engineers in industry, in government agencies and in consulting offices are very close together. So the civil engineering employees of industry and of consultants are not at all ahead financially as a result of the "efficiency" of private enterprise.

The huge profits made by consultants from the state governments since World War II have gone into the pockets of a few owners. These men have been concerned very little with raising the professional status or the wages of their engineering employees. In fact, in most consulting firms it is impossible for an engineering employee to buy a share of stock in the company for which he works. In other words "consultants," as we use the word in civil engineering, are business men first, and then engineers, and in point of numbers, they are very much in the minority in the ASCE.

When it comes to a comparison of the costs of engineering services rendered by public and private agencies, perhaps the state government accountants and economists are counting pennies and waking up to the fact that the states are paying excessively high fees for contract plans. Perhaps that is why the highway departments in Michigan and Pennsylvania are being rebuilt—to save the taxpayer a lot of money.

As for California, most enlightened civil engineers well know that this state has perhaps the best highway engineering department in the country. The civil engineers in California do not seem to mind a bit the lack of consultants for highway work in their state. In fact, California is a shining example of the fact that the offices of highway consultants can be entirely eliminated and the work done more economically without them while the civil engineer is advanced both professionally and financially.

Mr. Walsh infers that government agencies are afraid to publicly compare the costs of private and public engineering work. On the contrary, I am sure that government agencies have no interest in exposing the high fees the taxpayers are paying to highway consulting offices, and in comparing them, very favorably, with the relatively low cost of public engineering.

JOHN T. WEIRICK, M. ASCE
U.S. Bureau of Public Roads

Arlington, Va.

Unrepresentative of fact and experience

TO THE EDITOR: How can the same excellent issue of CIVIL ENGINEERING—April 1959—that presents President Friel's fine "Journey Toward a Successful Life" (p. 37) also carry the article by Donald A. Walsh, A.M. ASCE, "What Price Socialization of Engineering?" (p. 56)

Perhaps the second inspirational article in the April issue, "Great Opportunities—in Civil Engineering Research," by Lee A. Du Bridge (p. 45), will excuse the slip in editorial policy which the Walsh article represents in my opinion. To me this article is so inflammatory, so misrepresentative of fact and personal experience, as to lead to a recommendation for more care in editorial policy. As a policy, moot questions should never be discussed in print except on one side of a pro and con sheet.

To give equal time and space to rebuttals does not solve the problem in public print since the busy round of readers' activities causes some of them to catch the initial article and miss the rebuttal, or vice versa. Thus such articles encourage intolerances—of which the engineer needs only technical ones.

I have thirty years of my "journey toward a successful life" upon which to draw in analyzing the Walsh article. I find agreement with only one idea in it, the following:

"When an economically feasible project cannot be handled by an individual or group of individuals because they cannot assemble the resources, cannot stand the risk, or want an early return on their investment, the public must act if the best use of our resources is to be achieved."

In my "journey" and writings I had a plan to take from federal service all the experience I could get, then to advance to state work, and finally to become valuable enough to change to a job in industry or private engineering practice. This is not the way things have worked out. Yet I am not so intolerant as Mr. Walsh of other members of our profession.

Had Mr. Walsh analyzed his point of view by explaining his loose use of the terms "socialization," "free enterprise," and "engineering," he might have made his article palatable even though it remained biased.

HENRY J. TEBOW, M. ASCE
General Engr., Design and Construction Div., U.S. Bur. of Reclamation

Denver, Colo.

Agreement on "socialization" trend is voiced

TO THE EDITOR: Congratulations to Donald A. Walsh for his courageous discussion on socialization of engineering, which appeared in the April issue.

Mr. Walsh's statements have brought to public attention many facts and conditions that are well known and discussed privately throughout the profession. It is sincerely to be hoped that the article will be successful in stimulating organized resistance to the present trend. I have zealously circulated my copy of the April issue throughout our office.

CECIL F. COLLINS, M. ASCE
Alhambra, Calif.

Gate valves and axisymmetric orifices

TO THE EDITOR: I found the article, "The Gate Valve as a Flow Metering Device," by W. J. Tudor (January issue, p. 64) very interesting. There appears to be a striking similarity between the values of the loss coefficient K for gate valves and those for axisymmetric orifices as given by Herbert Addison (*Hydraulic Measurements*, John Wiley & Sons), as follows:

$\frac{\text{Area of orifice}}{\text{Area of pipe}} = \frac{A_o}{A_p}$	Loss Coefficient, K
0.2	50
0.3	20
0.4	9
0.5	4

This similarity becomes evident when the ordinate of Mr. Tudor's Fig. 1 is considered to represent not only the ratio pd_s/D but also A_o/A_p for axisymmetric orifices. When Addison's values are plotted, it is found that the scatter around the line representing Mr. Tudor's Eq. 1 is less than that for some of the data used in establishing this equation.

If the loss coefficient for both gate valves and orifices is assumed to be solely a function of the ratio of areas, A_o/A_p and A_g/A_p (where A_g represents the area of the gate-valve opening) then this correlation would not be expected because the value of A_g/A_p is not numerically equal to the corresponding value of pd_s/D. For the range, $0.2 < A_g/A_p < 0.5$, A_g/A_p is approximately 25 percent greater than pd_s/D. If this assumption were true, then the loss coefficient for a gate valve would be less than that for an axisymmetric orifice when $A_o/A_p = pd_s/D$.

The similarity between Addison's and Tudor's data indicates that the loss coefficient is a function of at least one other parameter besides the ratio of areas. In actuality, K for a gate valve is higher than that for an axisymmetric orifice when A_g/A_p is equal to A_o/p. This is logical because the gate projects further into the region of high velocity, thus disturbing it to a greater extent than the orifice. In addition, the axisymmetric orifice is symmetrical about the pipe axis whereas the gate of a valve is not.

It might be concluded then that the similarity between the gate valves and orifices as depicted by Mr. Tudor's Fig. 1 is due to a fortuitous cancellation of opposing trends. None the less, it is of interest to the design engineer because it places in his hands a single relationship which is applicable to both gate valves and axisymmetric orifices. It would seem logical to apply Mr. Tudor's results to the evaluation of the loss coefficient for segmental orifices.

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U. S. Geological Survey

Iowa City, Iowa

SOCIETY NEWS

ASCE Cleveland Convention—A Success

The importance to the Cleveland area of the Great Lakes for transportation and water supply was highlighted in several of the more than 100 technical papers presented at the ASCE Convention, held in Cleveland, May 4-8. Service problems of limited-access Interstate Roads were featured in several papers. Ellis Armstrong, Commissioner of the Bureau of Public Roads, told of the current status of the Interstate Highway System in a featured talk (page 57). Prof. Ralph Fadum, of North Carolina State College, reported on "Engineering Education in the USSR" from the vantage point of a recent trip to Russia sponsored by the State Department (page 112). Other papers covered the gamut of civil engineering activity from education through the full professional career.

Frank A. Marston Is Nominee for President

The Board of Direction selected Frank A. Marston, partner in Metcalf and Eddy of Boston, as the official nominee for 1960 President of the Society. Election is by letter ballot during the summer, with installation of the favored candidate during the Annual Convention of the Society—this year in Washington, D. C.—October 19-23. Mr. Marston was a Director of ASCE from 1952-1954 and Vice-President from 1956-1957.

Cleveland Section Convention Host

The Cleveland Section was an exceptional host. Under General Chairman W. R. Swatosh, technical program chairman J. B. Scalzi, and luncheon chairman John King, five days of highly informative meetings were well conducted. G. Brooks Earnest, as head of the reception committee, saw to it that all were enthusiastically welcomed to Cleveland. A highlight of the entertainment was watching the League-leading Cleveland Indians trounce the second-place Baltimore Orioles after a dinner at the stadium and an opportunity to meet the leading players. Of special interest was an evening at the beautiful new Cleveland Engineering and Scientific Center, which Toastmaster J. R. McKinney described as a monument to cooperation between bankers and engineers.

The St. Lawrence Seaway

The St. Lawrence Seaway, and its importance to the Great Lakes area, was a principal theme of the technical sessions at Cleveland. The largest freighters ever to traverse the St. Lawrence brought goods from world ports to Cleveland during the Convention. Twelve midwestern states are favorably affected by the foreign trade potential of the Seaway, W. G. McLennan, of the U.S. Army Corps of Engineers, told a session of the Waterways and Harbors Division. The twelve-state area includes a fourth of the land area of the continental U.S. and 30 percent of the population. The area produces 37 percent of the dollar value of manufactured goods and 42 percent of the agriculture, all within 200 miles of a Great Lakes port.

Col. Loren W. Olmstead, of the Corps of Engineers, Buffalo, told a joint member and student luncheon about the new and older locks on the St. Lawrence Seaway. Construction was done jointly by the U.S. and Canada with our northern neighbor having an especially big job where the river is all in Canada.

A minimum 25-ft channel will be available to the Upper Great Lakes by 1960, W. E. McDonald, of the Corps of Engineers, Chicago, said. If expected funds are made available, a 27-ft depth for both upbound and downbound channels will be a reality in 1962.

Another Army Engineer speaker, Frank P. Gaines of Nashville, told how studies of a canal connection between Barkley Reservoir on the Cumberland River and Kentucky Reservoir on the Tennessee River had resulted in reduction of a required navigation channel width from 600 to 300 ft, with a navigation depth of 11 ft. This channel would meet anticipated flood flow needs but detailed power studies may show justification for a larger channel.

Water and Water Control

Cleveland will have a maximum-hour water demand of 850 mgd in the year 2000, compared with 600 mgd in 1960,

Membership Luncheon photo shows Frank Marston (left), nominee for next president of ASCE, with Harry F. Burmester, the speaker, president of the Union Commerce Bank of Cleveland. With them are ASCE President Francis Friel and G. Brooks Earnest, president of Fenn College and toastmaster at the luncheon.

Archie N. Carter (left) consulting engineer of Minneapolis, stops to talk with Past Director R. Robinson Rowe of California (center), editor of N. G. Neare's column in "Civil Engineering," and Don King, who has recently rejoined the ASCE staff as an Assistant to the Secretary.

Ellis L. Armstrong, commissioner of the Bureau of Public Roads (left), reported to a Convention luncheon on the National Highway Program. In center is S. B. Morris, ASCE Vice-President for Zone IV, with W. B. Hanlon, president of the Cleveland Section.

J. W. Avery, of the Cleveland and New York consulting firm of Havens and Emerson, told a Sanitary Engineering Division session. A complete hydraulic analysis of the distribution system has been made in each of the Cleveland service districts to design the facility for the next 50 years.

The *Cleveland Plain Dealer* editorially supported the recommendation for more water from Lake Erie stated as a necessity by Frank Edwards, of the Stanley Engineering Company, Chicago. Water requirements for northeastern Ohio soon will exceed supplies from all potential surface and ground water sources except the lake. But industrial and domestic growth can continue only if other supplies are supplemented by water from Lake Erie. Water can be delivered to areas located inland at a cost that is competitive with water from other sources.

Geophysical exploration methods have been adapted to the search for water, H. R. McDonald and Dart Wantland, of the U.S. Bureau of Reclamation, told an Irrigation and Drainage Division session. Means used include seismic, electrical resistivity, a magnetic method, and even gravity. Electrical resistivity is most useful under most conditions and is effective to depths of 500 ft.

Existing political subdivisions rarely have facilities, authority, and flexibility of action necessary to cope satisfactorily even with local problems of flood control, C. C. Chambers, consulting engineer of Dayton, told a Hydraulics Division session. Rather, flood control and water-use problems tend to divide themselves into stream drainage areas. The Miami Conservancy District, financed with funds derived from now fully paid assessments on appraised benefits; the Upper Scioto Drainage and Conservancy District, the first to be organized in Ohio, also financed solely with assessments levied on benefits; and the Muskingum Watershed Conservancy District—each is an example of satisfactory solution of the problem of protection of several communities in one drainage area.

Statewide control and supervision of ground-water operations to avoid conflicts in the use of such water and protect the quality, were urged by Robert O. Thomas, of the California Department of Water Resources, Sacramento, in a session of the Irrigation and Drainage Division. Now most ground-water control is under district or regional jurisdiction within states. "It is felt that, because of the ofttimes large geographical coverage required for ground-water operations and the frequent necessity of coordinating conservation activities in widely separated regions, control and supervision should not be delegated to an agency of less than statewide authority," Mr. Thomas declared. It is not necessary that such an agency actually design, construct, or operate conservation projects although that might be desirable in certain circumstances. The agency should have the responsibility to (1) review, (2) approve, modify or disapprove, (3) supervise, (4) coordinate, and (5) regulate the organization, plans, financing, construction, and operation of districts or other agencies engaged in the development and utilization of ground-water for beneficial use.

Two from Tennessee at the Convention—ASCE Honorary Member Nathan W. Dougherty (left), dean emeritus of the College of Engineering, University of Tennessee, and ASCE Director Don Mattern, of the Tennessee Valley Authority.

Mass Transportation

On a City Planning Division program W. J. McCarter, general manager of the Chicago Transit Authority, suggested the use of self-guided bus trains within the rights-of-way of multi-lane expressways as a plausible means of solving the public transit problem of large cities.

The proposal is still in the study stage, but there is ample reason to believe that self-guiding bus trains, traveling at speeds up to 70 mph on puncture-proof tires, can be operated in especially prepared, exclusive lanes of grade-separated expressways. Construction costs would be less than for conventional rapid transit. Noise would be minimized by rubber-tired wheels. In outlying areas, buses equipped for self-guided train operation could be scheduled as manually-guided single units to collect passengers, then assembled at appropriate locations and coupled into trains for self-guided express runs in exclusive rights-of-way.

Services on the Interstate

Charles L. Dearing, executive director of the Illinois State Toll Highway Commission, told the ASCE Convention that the motoring public will expect built-in safety on all limited-access highways. Features such as adequate guard rail, fencing, delineators, and much improved signing should be integrated at the outset of design rather than regarded as appendages. Like toll roads, limited-access highways need to have food, fuel and information services at convenient intervals. Mr. Dearing was the first speaker on a Highway Division Panel on Adequacy of Services for the Travelling Public on Controlled-Access Highways.

On the Ohio Turnpike an average of 120 emergency services per mile of road were supplied in 1958, according to C. W. Hartford, of the Ohio Turnpike Commission. In most instances no roadside services are planned for the rural interstate highways. Tow vehicles providing emergency services on a controlled basis generally will not be available so "gypsy" mechanics will be out to make a fast buck. More police service will be necessary on the Interstate System than on the toll roads to make up for lack of services.

Connecticut has need for parking areas at interchange points on controlled-access highways to accommodate "car poolers" Robert G. Mitchell, of the Connecticut Highway Department, said. The state tried to discourage such parking and transfer to other cars by "No Parking" signs, but they merely inconvenienced the riders instead of stopping the practice. At rural intersections as many as thirty cars may be left all day by car poolers.

R. C. Keeling, of the Kansas Turnpike Authority, questioned whether the travelling public is best being served by chasing all services away from the road. Current standards on the Interstate System are restrictive so that cars will have to pull off the road to get services they are accustomed to find conveniently on toll turnpikes or on earlier road systems.

In a paper prepared by R. R. Bartelsmeyer, chief highway engineer of Illinois, it was noted that the study of transportation is far less advanced than most other engineering subjects. It is a more difficult problem because the subject is cities, people and vehicles—and these cannot be controlled or experimented with in a laboratory.

Pipelines for Transporting Solids

Julian Nardi, chief mechanical engineer of Ford, Bacon & Davis, Inc., New York, told a joint session of the Pipeline and Power Divisions that pipeline transportation of coal or similar bulk solids will not replace railroad transportation as rapidly as it did in the case of crude oil and petroleum products. But as railroad tariffs increase, more and more solids will be pumped overland, especially where water transportation is not available and where a slurry or fine sizes of the solids are desirable.

Partial processing of a solid while in transit, such as wood chips into pulp, may be the key to a whole new line of products that can be economically pumped through a pipeline. Already coal, limestone slurry, borax, and other chemicals are being transported through pipelines, Mr. Nardi reported, and moving wheat from the Canadian prairie provinces to the Great Lakes is proposed.

A. G. Purdue, of Fluid Systems, Inc., New Haven, Conn., told the engineers that a new 100,000-kw power plant in Puerto Rico is getting a high viscosity tar pitch for primary fuel through a heated pipeline from a nearby refinery. The hi-vis material, which is all but unmanageable by the usual techniques for handling and storage, represents a considerable fraction of each barrel of crude oil—20 to 30 percent. It has a liquefaction temperature around 250 deg F and flows readily at about 350 deg F. It burns at 450 deg F. Its heating value is comparable to bunker oils in general use. A thermal electric pipeline is used for transporting the hi-vis, utilizing the reactance of the pipe itself to transform electrical energy into heat to maintain a constant temperature along the length of pipe.

Construction for Power

To accommodate the growing power needs of 138 communities in northeast Ohio, the Cleveland Electric Illumination Company has a construction budget of $200,000,000 for the next five years after spending $56,000,000 in 1958 and committing itself to $38,000,000 for 1959, Russell G. Stewart told a Power Division session. The company's system includes four interconnected power stations with a net generating capability of 1,909,000 kw, soon to be increased to 2,151,000 kw by completion of the Avon station.

In a how-to-do-it paper Albert G. Masters and Ernest J. Gessing, of the Cleveland Electric Illuminating Company, told how to raise transmission towers with energized lines. Towers more than 100 ft high were raised quickly without

G. Brooks Earnest (left), of Cleveland, with 94-year-old Edward J. Crook, who works every day as chief computer with the Cleveland Regional Geodetic Survey.

President Friel looks over flyer inviting ASCE conventioneers to Phoenix in April 1961, as Vice-President S. B. Morris, of Los Angeles, Executive Secretary Wisely, and Director E. L. Durkee of Bethlehem, Pa., listen to the pitch of Director Wayne G. O'Harra (center) for "Fun in the Sun in '61" convention in his home town of Phoenix.

The Pipeline Division Executive Committee met during the Cleveland Convention. Left to right are J. B. Spangler, secretary; F. C. Culpepper, Jr.; J. E. Thompson; and A. E. Poole, chairman. W. T. Ivey, not present, is also on the committee.

expensive equipment by lifting them vertically and installing a 10-ft additional section at the bottom. Special devices were used to keep the tower centered as it was raised by wire rope lines to a power winch on the maintenance truck. About 250 man-hours of time were required for raising a 12-ton tower, but it is expected that the time will be decreased as crews become more familiar with the work and details are simplified.

The Tennessee Valley Authority will add three units totaling 162,000 kw capacity to the existing Wilson Dam. Details were given by Robert A. Monroe, chief design engineer of TVA. Wall spaces left in the powerhouse for additional units when it was built (1916-1925) have been previously filled. Supplemental steam power and a greater amount of regulated water on the Tennessee system make the new units economical. They will be installed in the sluiceway section adjacent to the existing powerhouse. In contrast to the present indoor-type units, the additional ones will be outdoor type and have twice the capacity. Wilson Reservoir has very little storage so it will be economical to add similar units at Wheeler Dam immediately upstream, where reservoir capacity for peaking is available. The Wilson Dam addition is currently being designed, and construction will begin soon. The Wheeler addition is in the preliminary design stage with construction scheduled for next year.

John A. Bailey, of the Atomic Power Equipment Department of the General Electric Company, spoke on pressure volume considerations for reactor containment vessels. He commented that precautions taken in design and operation make a container accident very remote but protection is still quite necessary. The containment vessel must withstand the effects of energy release or generation. Since the expense of placing containment vessels around nuclear power plants is quite high, considerable thought is being given to methods of reducing costs. One system now under consideration for reducing peak enclosure pressures puts the reactor vessel in a chamber vented to the enclosure through a pool of water. The water would condense the escaping vapor, reducing the peak pressure. Water has a further advantage of trapping a portion of fission products that might be released.

In a paper on seismic considerations for nuclear installations—presented at a joint session of the Structural and Construction Divisions—R. R. Alvey, chief engineer of the Nuclear Division of Holmes and Narver, recommended that such installations anywhere in the world receive a design treatment consistent with the Mercalli 5 or Zone 1 intensity as specified by the Uniform Building Code, as an absolute minimum of protection. Atomic installations must be analyzed as a complete system. It is not sufficient to review individual items without considering the consequence of some degree of failure upon other parts of the system. The implications of an accident triggered by an earthquake are so serious that the world cannot afford to gamble on such an occurrence.

Student Conference, presided over by R. Haak (left), of the Fenn College Chapter, heard T. W. Hoff, consulting engineer; R. G. Harley, of Albert M. Higley Co., contractors; O. Hoffman, of Cleveland Pneumatic Tool Co.; and Prof. George Barnes, of Case Institute of Technology, tell about education and opportunity beyond the undergraduate level.

Featured Talks

A college degree does not label a man an engineer or scientist forever, was the warning of Harry C. Kelly, of the National Science Foundation, speaking at the opening-day luncheon. With the rapid developments in engineering science, continuous study is needed to keep up to date. And we have as much to learn from as to teach to foreign friends and institutions.

The 700,000 engineers and 250,000 scientists in this country are only ½ of 1 percent of the population, yet creative engineers and scientists hold the key to the future. The basic problem is improving the quality of instruction in high schools and colleges during a period of greatly increased enrollment. In this field the National Science Foundation is placing great emphasis on providing highly-trained, enthusiastic, and well paid teachers at all levels.

Canada is justly proud of its engineering achievement on the St. Lawrence, both current and over more than 100 years of development, said R. F. Legget, director, Division of Building Research, National Research Council of Canada, in a luncheon talk on "Engineering Astride

Setting up for a Waterways and Harbors Division session is Richard Pozderak, Jr. (left), who operated the machine, with speakers J. Norman Gau and L. S. Horihan, both of the Army Corps of Engineers, Omaha, and J. A. Harder, assistant professor of hydraulic engineering, University of California, Berkeley.

Mrs. Eugene F. Baldi, chairman of the Women's Activity Committee for the Society's Convention at Washington in October, pledges ASCE Vice-President S. B. Morris of Los Angeles to attend. Mr. Baldi, left, is general chairman for the Convention. D. B. Ventres, right, is Director of District 5, which includes the National Capital Section.

the Border." The all-Canadian Welland Canal, completed in 1932 at a cost of $131 million (current replacement estimate $350 million), is an achievement that made the rest of the waterway feasible at this time. He outlined the long history, and sometimes frustrations, of coordinating the financing and politics of the two countries to get great projects underway.

Mr. Legget concluded with the inscription in stone on the great powerhouse at Barnhart Island: "This stone bears witness to the common purpose of two nations whose frontiers are the frontiers of friendship, whose ways are the ways of freedom, and whose works are the works of peace."

Ralph M. Besse, executive vice president of the Cleveland Electric Illuminating Co., took a 40-year look at northeastern Ohio following the convention dinner. He foresees a fabulous growth for the area, endangered on a national scale by inflation, unbalanced labor cost, and pricing ourselves out of foreign markets. He expects there will be greater socialization of engineering services and that all will be living with less individual opportunity and more governmental cradle-to-grave care. The influence of home, church and school will decrease and economic institutions—corporations and labor unions—will be more dominant. Mr. Besse expects more serious racial problems in the U.S. He predicts that Negroes' underprivileged status will completely change.

Banker Harry F. Burmester of Cleveland expects a 6 percent rise in construction activity to $52 billion in 1959. Plant and equipment purchases will be up 5 percent to $33 billion, still well below the $37 billion record of 1957. The gross national product will be up perhaps 8 percent from the 1958 total of $440 billion, a figure that may rise to $750 billion by 1970. Mr. Burmester challenged the civil engineers at the Membership Luncheon to work with bankers to keep national affairs in hand by resisting special-interest groups. Only in this way can inflation be controlled and the Federal budget balanced.

Conditions of Practice Program

The "Professional Development of Civil Engineers" was studied in an interesting Department of Conditions of Practice program, one of the features of the Wednesday morning meeting. Fenn College President G. Brooks Earnest moderated the program, which appraised the need for professional development.

ASCE Honorary Member Nathan W. Dougherty, dean emeritus of the College of Engineering at the University of Tennessee, concluded his talk on "Methods of Accomplishing Professional Development" with a plea for "more printed material on the canons of engineering practice."

Said Dean Dougherty, "An item of great personal development is writing for publication; this improves the writer and attracts favorable attention to the employer. In addition, the profession is benefitted by its members having available new ideas and new methods. The atmosphere and climate of employment should be such that engineer employees are encouraged to attend professional meetings and to contribute to their programs. Engineers today build upon the shoulders of those who have gone before, and they currently aid their fellows in making available solutions of problems generated by the industry of today.

"Professionalism is a way of thinking and living rather than an accumulation of knowledge and power. Knowledge and power are exceedingly important, but professionalism has to do with their use rather than with attaining them."

President Friel's Address

President Friel's Annual Address, covering a number of aspects of professionalism, was the other featured event of the Wednesday morning meeting. The address is abstracted elsewhere in this issue.

ASCE Names Five Honorary Members

Five distinguished members of ASCE were elected to honorary membership in the Society during the Cleveland Convention meetings of the Board of Direction. They are:

Herbert A. R. Austin, prominent Hawaiian engineer. Mr. Austin was the first chief engineer of the Honolulu Public Works Department, and is currently serving as consultant to the Territorial Commissioner of Public Lands on a multimillion-dollar Honolulu waterfront project.

Glen E. Edgerton, Major General, U.S. Army (retired), of Washington, D. C. He is former governor of the Panama Canal Zone and former president and chairman of the board of the Export-Import Bank of Washington.

Julian Hinds, consulting engineer of Los Angeles and former ASCE Director. Mr. Hinds was one of the designers of the Colorado River Aqueduct, designated by ASCE as one of the "Seven Civil Engineering Wonders of the United States."

Frank M. Masters, well known bridge engineer of Harrisburg, Pa. Among the important bridges constructed during his association with the consulting engineering firm of Modjeski & Masters were the Huey Long Bridge and the recently completed Greater New Orleans Bridge across the Mississippi.

Gustav J. Requardt, prominent sanitary and water supply engineer of Baltimore, Md., and former ASCE Director. Mr. Requardt's firm, Whitman, Requardt & Associates, has also done engineering design work on highways, bridges, airfields, and industrial buildings.

Presentation of their honorary membership will be a feature of the Annual Convention in October. Biographies and photos of the new Honorary Members will be published in the October issue.

ASCE Board Meets in Cleveland

The ASCE Board of Direction met in Cleveland early in May during the Convention. Several actions of broad importance to the Society were taken. Many other items were studied, and some of them were referred to committees for action. Several of the Board's actions are briefed here.

Effective for the next fiscal year, **members on Society business will be reimbursed** for the actual amount expended for air or train fare, but not for more than the cost of first-class air travel. A per diem of up to **$25** will be allowed for each meeting day to cover hotel, meals, local transportation, and gratuities. As at present, no reimbursement will be authorized for travel totaling less than 100 miles a round trip.

Lease for ten years of the **ASCE property on 57th Street** in New York City was authorized. The tenant is again the Frank G. Shattuck Company, operators of the Schrafft restaurants.

On the recommendation of the Committee on Division Activities, the Board voted to seek, through Kenneth W. Markwell, suggestions as to how ASCE might supplement the study of **civil defense problems** currently under way in the Federal Civil Defense Administration.

It was voted that the Executive Secretary of ASCE be requested to furnish frequent detailed statements of **Technical Division expenditures** to the chairman and secretary of the Division. Listing in the Official Register of the names of nonmember advisers to technical committees was authorized.

On recommendation of the Committee on Research, the Board agreed to suggest to the Committee on Convention Policy and Practice that the Awards Luncheon at the Annual Convention be renamed the **Research Luncheon** and that the responsibility for programming be assigned to the Research Committee.

On recommendation of the **Committee on Society Honors,** the Board approved a plan for annual selection of "the outstanding civil engineering achievement" of the year, with appropriate publicity to increase interest in civil engineering structures. An early issue of CIVIL ENGINEERING will have details on making nominations for this award.

The deadline for Local Section suggestions for **changes in boundaries of Districts and Zones** has been extended to October 1. Twelve Sections have sent in suggestions for changes; twenty have reported no desire to change.

On recommendation of the Committee on Publications, the Board voted to make the **Journal of Professional Practice** available on the same basis as Technical Division Journals, giving the member the option of choosing the Journal of Professional Practice as one of the two Division journals to which he is entitled.

The Board authorized publication of ASCE **Technical Division conference proceedings** on a self-liquidating basis under supervision of the Committee on Publications. This will permit immediate printing of all the papers from a technical conference for distribution outside the regular publication procedures, if it can be shown that sales will reimburse the cost.

Printing of 100,000 copies of "Your Future in Civil Engineering," in larger format with improvement in content and layout, has been authorized at an estimated cost of $8,500. No further printing of the booklet, "You Can Be A Civil Engineer," is contemplated at present.

On recommendation of the Committee on Student Chapters, the Board approved establishment of **Student Chapters of the Society** at Valparaiso University in Indiana and the Colorado School of Mines.

On recommendation of the Committee on Engineers in Public Practice, the Board requested the continued attention of the Society toward action on the part of **federal agencies** to expand their activities into the field of private practice. In 1948 ASCE adopted a policy of opposition to such activity.

Formation of a **cooperative committee** with the American Institute of Planners was authorized. The committee will be called the ASCE-AIP Joint Cooperative Committee.

Functions of the **Committee on Cooperation with Local Sections and Regional Councils** were assigned to the Committee on Local Sections.

The Board voted that the Society should reaffirm its policy approving, endorsing, and supporting the creation by Congress of a joint commission to make a comprehensive, all-inclusive, **study of the pay systems of the three branches of the Federal Government,** in substantial accord with House Document No. 423, which is essentially a message from the President of the United States relating to compensation of government employees. The Board also voted that ASCE should support in principle **Federal Bills** HR 1929, HR 5719 and HR 5721 on this subject (which have been referred to the House Committee on Post Office and Civil Service) and that it encourage early hearings on these bills and make presentations in support of the bills when such hearings are held. Further, if and when such legislation is enacted, the Society should recommend to the White House that **at least one member of the commission be a professional engineer** active in one of the nationally recognized professional organizations. It was agreed that the Society should state its opposition to provisions for including engineers in the coverage of the Bacon-Davis Bill, S 1119, which relates to prevailing wages, and that the Secretary be authorized to take appropriate measures.

Awards Authorized

The Board appointed Robert W. Gerstner, of the Technological Institute of Northwestern University, ASCE **Research Fellow** for the 1959-1960 academic year. The award is being made for the first time.

The Board appointed Willard E. Fraize, of Massachusetts Institute of Technology, ASCE **Freeman Fellow** for the 1959-1960 academic year.

Charles E. Trout, ASCE Treasurer, Is Dead

The ASCE staff has been saddened by the death of Charles E. Trout who contributed his services to the Society as treasurer from 1941 until his death on April 19, at the age of 87. Since his retirement from active practice in October 1954, Mr. Trout had been living at Westerleigh, Staten Island. Mr. Trout had

been in the Society for sixty years, having become a Junior Member in 1899. He had been a Member since 1906.

Long prominent in waterfront construction and dredging operations, Mr. Trout was vice-president and manager of the Atlantic Division of the Great Lakes Dredge and Dock Company from 1937 until his retirement. He was in charge of dredging operations for such major structures as Navy drydock facilities at Philadelphia, Brooklyn and Portsmouth, Va. During World War II, Mr. Trout also worked for the Navy on dredging operations at Trinidad, B.W.I. He had been associated with metropolitan projects since 1900. He was an 1896 graduate of Massachusetts Institute of Technology.

New ASCE Membership Designations Now in Effect

Effective June 6, the changed membership designations voted by the ASCE members take effect, a month after presentation of the result of the ballot to the business meeting of the Society at Cleveland.

Automatically and without action on the part of the individual those who are presently Member, Associate Member or Junior Member become Fellow, Member or Associate Member, respectively. The designations for Honorary and Affiliate members do not change.

Individual notice of change of designation will not be made. Members may now use the new designations for letterheads, business cards and in listing affiliations as has been considered proper in the past (Official Register 1959, page 86)

Persons currently eligible to transfer to a higher grade in the Society under the old regulations have one year from June 6 to make application for transfer. After that time, and immediately for all new applicants for admission, the revised requirements are effective. These are:

1. **Fellow**—replaces Member grade and differs from it in these main respects:
   (*a*) Minimum age is raised from 35 to 40 years.
   (*b*) Minimum period in responsible charge is increased from five to eight years.
   (*c*) Legal registration as an engineer becomes a requirement for membership in the grade.
   (*d*) Admission is only by transfer from the grade of Member, after not less than five years of responsible charge of important engineering or other appropriate work in the grade of Member.

2. **Member**—replaces Associate Member grade but differs from it principally in these respects:
   (*a*) Minimum age is raised from 25 to 27 years
   (*b*) Minimum period in responsible charge is increased from one to three years

Entry is by advancement from the grade of Associate Member or by direct admission as at present.

3. **Associate Member**—replaces Junior Member, but with these major differences:

   (*a*) An applicant who is not an engineering graduate from a school of recognized standing is eligible for admission in this grade only if he has an acceptable Engineer-in-Training certificate.

   (*b*) Transfer to another grade, instead of being mandatory at age 32, is mandatory 12 years after admission to Associate Member grade unless, as now, an extension is granted for intervening military service.

Entrance fees will be:

Associate Member	$10.00
Member	25.00
Affiliate	25.00

There is no entrance fee for the new Associate Member grade for graduates who have been members of Student Chapters and who apply for membership within 60 days after graduation. There is no fee for transfer between grades.

Annual dues are:

Associate Member—	
First seven years after admission to this grade	$15.00
Thereafter	25.00
Member	25.00
Fellow	25.00
Affiliate	25.00

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.13	1.22
Baltimore	1.12	1.11
Boston	1.18	1.15
Chicago	1.36	1.30
Denver	1.21	1.20
Houston	1.20	1.12
Kansas City	1.11	1.14
Los Angeles	1.21	1.21
Miami	1.57	1.57
New Orleans	1.03	1.21
New York	1.25	1.21
Pittsburgh	0.95	1.05
Portland (Ore.)	1.16	1.11
San Francisco	1.24	1.19
Seattle	1.06	1.06

Highway Departments

Region	Current	Previous
I, New England	0.92	0.89
II, Mid. Atlantic	1.13	1.17
III, Mid. West	1.16	1.25
IV, South	1.08	1.10
V, West	1.02	1.02
VI, Far West	1.11	1.15

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current salary total for ASCE Grades I, II and III by an arbitrary base. The base is $15,930. This is the total of salaries paid in 1956 for the equivalent Federal Grades GS5, GS7 and GS9. Only the annual base entrance salaries are used in these calculations. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was January 31, 1959.

Long-Time Employees Honored by Board

The ASCE Board of Direction has recognized faithful service to the Society by award of watches to those on the staff for more than 25 years. At left, seated, are Ruth Campbell, associate editor, and Mary E. Jessup, news editor of "Civil Engineering," who have been on the staff since the magazine was founded in 1930. Next are Ethel Colligan, administrative assistant, who has been with the Society 36 years, and Eleanora Seifert, circulation manager, with the Society 39 years. Left to right, standing, are Francis S. Friel, President of ASCE, who made the presentations for the Board; John A. Zecca, comptroller, and Emil A. Rothermel, mailroom supervisor, both with ASCE since 1930; Harold T. Larsen, manager of Technical Publications, on the staff since 1927; and William H. Wisely, Executive Secretary of ASCE.

Construction Schedule Set for the New UEC

Construction of the new United Engineering Center takes another step toward realization with release of a tentative working schedule that has been adopted by the United Engineering Trustees, administrators of the new Center for the participating societies.

The schedule calls for completion of working drawings for the eighteen-story steel-frame building with metal, glass, and limestone exterior on August 30, 1959. The drawings are being prepared by the architects, Shreve, Lamb and Harmon Associates, with the cooperation of Seelye, Stevenson, Value & Knecht, the structural engineers, and Jaros, Baum & Bolles, the mechanical engineers. Greater economy will be effected by the recent decision to have an eighteen-story building (two ground floors, plus a sixteen-story tower) instead of the twenty-story structure originally planned.

Confirmation of the guaranteed limit of cost by the Turner Construction Company is scheduled for September 30, 1959, and the start of construction for October 15. Completion of construction is planned for March 15, 1961, and completion of requirements for occupancy (to be handled by the various occupants themselves) for July 1, 1961.

The Campaign for Funds Continues

Needless to say, if this schedule is to be carried out, the campaign for funds must be brought to an early finish. As of May 8, the drive was 83 percent complete, with industry having pledged 86 percent of its $5,000,000 goal, and the participating Societies 78 percent of their $3,000,000 goal. Tops among the individual societies is the AIChE, which is on the verge of meeting its goal, with 97 percent of its quota either pledged or collected. ASCE is in fourth place among the five Founder Societies, having met 61 percent of its quota—thanks to the interest and generosity of only 7,915 of our 42,774 members! Another ASCE Section, the Arizona, has reached its goal and is fifteenth on the Honor Roll.

In a review of the ASCE Member Gifts Campaign during the recent Cleveland meeting of the Board of Direction, President Friel noted that pledging must continue at the rate of $60,000 a month in order for the Society to meet its quota by September 30. Members of the Board were generally optimistic in discussing the progress and status of the campaign in their respective Districts and Zones. To aid Local Section officers in completing their campaigns, the Board asked Secretary Wisely to prepare lists of the names of all donors with the amounts pledged in each Section. It is hoped that these lists will assist the Sections "in organizing and reinvigorating the drive for pledges from select prospects."

The women engineers and ladies' auxiliaries are continuing their efforts in the drive for funds. One of these groups recently reporting is the ASCE Philadelphia Ladies' Auxiliary, under the chairmanship of Mrs. A. A. Estrada, with a contribution of $100. Thanks, too, to the members of the American Concrete Pipe Association, who have contributed a generous $36,000. ASCE Director Howard F. Peckworth is managing director of the association.

President Friel, in his annual address (abstracted on page 45) calls the fund raising for the Center "perhaps the most important new activity of the Society this year." Noting that we need better headquarters facilities for technical publications, for meetings and conferences, and for the multiple other activities that are the core of the ASCE program, he sees the new Engineering Center as a laboratory or workshop that will make a "tremendous difference in ASCE operations and, in a larger sense, in the Society's service to the profession."

What the campaign for UEC funds means in terms of paying for the structure. Bar graphs superimposed on artist's rendering of the Center show the status of ASCE's campaign (62 percent complete) in comparison with the efforts of other groups.

ASCE Giving Passes $494,315 as of May 8

Local Section	Quota	Amount Pledged	% Quota
ZONE I (1219)	$197,300	$137,080	69
District 1 (612)	**133,300**	**93,713**	**70**
Brazil (4)	2,100	190	9
Metropolitan (535)	119,200	88,466	74
Panama (6)	1,300	205	16
Puerto Rico (27)	3,100	2,800	90
Rep. Colombia (6)	2,400	230	10
Venezuelan (34)	5,200	1,822	35
District 2 (334)	**43,400**	**26,114**	**60**
Connecticut (102)	11,000	8,318	76
Maine (66)	4,700	3,586	76
Massachusetts (118)	23,000	11,037	48
New Hampshire (15)	1,800	548	30
Rhode Island (32)	2,900	2,595	89
District 3 (273)	**20,600**	**14,753**	**72**
Buffalo (51)	4,400	2,740	62
Ithaca (47)	2,400	2,734	114
Mohawk-Hudson (63)	7,500	3,348	45
Rochester (41)	1,900	2,329	123
Syracuse (61)	4,400	2,842	65
ZONE II (1937)	169,700	98,891	58
District 4 (589)	**34,000**	**38,039**	**112**
*Delaware (109)	4,100	4,019	98
Lehigh Valley (89)	4,200	5,517	131
Philadelphia (223)	20,000	22,773	114
Central Pa. (168)	5,700	5,730	101
District 5 (301)	**27,000**	**8,126**	**30**
Nat'l Capital (301)	27,000	8,126	30
District 6 (473)	**49,000**	**24,729**	**50**
Maryland (191)	15,000	6,994	47
Pittsburgh (177)	17,000	9,428	55
Virginia (99)	13,300	4,731	36
West Virginia (8)	3,700	3,576	97
District 10 (372)	**59,700**	**25,497**	**43**
Alabama (57)	8,900	2,379	27
Florida (16)	11,500	1,250	11
Georgia (119)	11,000	7,183	65
Miami (8)	5,200	390	8
Nashville (58)	2,700	2,775	103
N. Carolina (34)	6,300	3,141	50
S. Carolina (92)	4,900	2,540	52
Tenn. Valley (188)	9,200	5,839	63
ZONE III (2306)	202,200	126,518	63
District 7 (352)	**39,900**	**15,314**	**38**
Duluth	1,500		
Michigan (53)	18,000	2,810	16
Northwestern (59)	8,000	2,650	33
Wisconsin (231)	10,700	9,413	88
S. Dakota (8)	1,700	416	24

Local Section	Quota	Amount Pledged	% Quota
District 8 (328)	**$37,100**	**26,568**	**72**
Cent. Ill. (72)	6,500	3,750	58
Illinois (214)	29,000	21,654	75
Tri-City (42)	1,600	1,164	73
District 9 (741)	**45,700**	**39,958**	**87**
Akron (34)	3,100	1,385	45
Central Ohio (149)	5,100	4,986	98
Cincinnati (126)	4,700	6,607	141
Cleveland (30)	9,300	3,900	42
Dayton (24)	3,300	2,030	62
Indiana (262)	11,000	13,564	123
Kentucky (104)	6,100	6,630	109
Toledo (12)	3,100	850	27
District 14 (211)	**31,500**	**14,175**	**45**
Mid-Missouri (42)	3,500	1,233	35
Mid-South (63)	11,000	5,534	50
Oklahoma (39)	6,900	2,319	34
St. Louis (67)	10,100	5,089	50
District 16 (674)	**48,000**	**28,003**	**58**
Colorado (41)	13,900	2,454	18
Iowa (115)	5,900	4,878	83
Kansas City (316)	12,000	12,927	108
Kansas (101)	7,600	3,499	46
Nebraska (89)	6,300	3,805	60
Wyoming (15)	2,300	440	19
ZONE IV (2282)	230,800	131,826	57
District 11 (1331)	**132,600**	**75,320**	**57**
Arizona (148)	5,000	5,399	108
Hawaii (212)	6,300	7,482	119
Intermountain (41)	4,700	1,917	41
Los Angeles (411)	50,200	20,524	41
Sacramento (133)	16,300	7,164	44
San Diego (59)	6,000	2,386	40
San Fran. (327)	44,100	30,448	69
District 12 (475)	**40,400**	**24,008**	**59**
Alaska (14)	2,200	790	36
Columbia (74)	2,200	2,803	127
Montana (19)	3,300	1,300	39
Oregon (80)	10,900	3,923	36
Seattle (115)	12,200	6,393	52
S. Idaho (40)	2,300	3,045	132
Spokane (49)	3,100	2,033	66
Tacoma (77)	4,200	3,406	81
District 15 (476)	**57,800**	**29,998**	**52**
Louisiana (57)	13,000	2,869	22
Mexico (1)	1,400	40	3
New Mexico (13)	4,000	705	18
Texas (405)	39,400	26,384	67
Totals (7,744)	$800,000	$494,315	62

Note: Number of pledges shown in parenthesis
*Reported to have reached 100 percent

Table 1. Quotas and Pledges to UEC as of May 8

Society	Goals in Dollars	No. of Subscribers	Amount Pledged	% of Goal	$ per Subscriber
ASCE	800,000	7,915	491,658	61	62
AIME	500,000	3,832	270,423	54	71
ASME	800,000	10,213	501,359	63	49
AIEE	900,000	19,820	745,566	83	38
AIChE	300,000	6,904	290,815	97	42
Others	. . .	803	54,658	. .	68
Total	*3,000,000	49,487	$2,354,481	78	47
Industry	5,000,000	413	4,315,819	86	10,500
Grand Total	8,000,000	49,900	6,670,300	83	

*While the overall goal of member giving is shown as $3,000,000, the quotas accepted by the Societies total $3,300,000.

UEC HONOR ROLL

Congratulations and thanks, once again, to the ASCE Local Sections that have met their goals in the drive for funds for the new United Engineering Center and are continuing to collect as much as they can. The Arizona Section has now been added to the growing list, which is repeated here. The Sections are listed in the order of meeting their goals, and the figures indicate percentages of quota attained on May 8.

Kentucky (109)
Lehigh Valley (131)
Nashville (103)
Cincinnati (141)
Columbia (127)
Philadelphia (114)
Hawaii (119)
Rochester (123)
Ithaca (114)
Southern Idaho (132)
Indiana (123)
Delaware (100)
Kansas City (108)
Central Pennsylvania (101)
Arizona (108)

Congratulations also to **District 4,** which continues to be the only Section that has exceeded its quota.

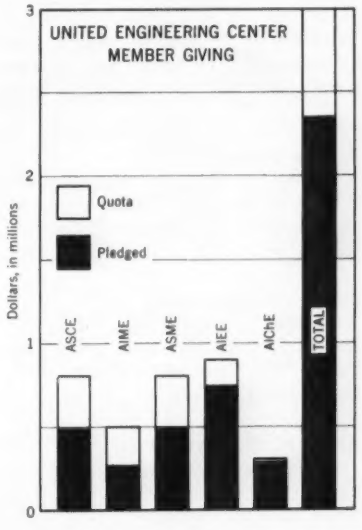


Fig. 1. Member giving for United Engineering Center as of May 8.

ASCE-AGC Guide to Bidding Procedure

A new bidding guide, prepared jointly by ASCE and the Associated General Contractors, provides the answer to many questions about proper bidding procedure. This is a well-rounded 12-page brochure—the product of highly qualified engineers and contractors. It capably fulfills the purpose implied by the title: "A Recommended Guide to Bidding Procedure on Engineering Construction."

The document is not intended for use in drawing up building contracts. However, it has broad application in the heavy construction field. Vital areas cov-

ered are: (1) Preliminary Investigation, (2) Plans, (3) Specifications, (4) Bidding, (5) Separate Contracts, and (6) Subcontracts.

Marginal subheads are a feature of the brochure's attractive 8½ x 11-in. two-color format. Clearly noted for ready reference are such items as: Local Ordinances; Royalties and Patents; Bases of Payment; Details of Plans; Contract Documents; and Deposits. These are but a few of the subjects that make the new brochure a useful guide to economies in engineered construction.

Single copies are free. Quantity orders, two or more, are available at cost—25 cents a copy, Address requests to ASCE, 33 West 39th Street, New York 18, N. Y. In ordering, please refer to the code number 1959-20.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closes May 1, 1960. See 1959 Official Register, page 143.*
FREEMAN FELLOWSHIP:	*1960-61 (closing date pending). See Official Register, page 154.*
ERNEST E. HOWARD AWARD:	*1960 award closes Feb. 1, 1960. See Official Register, page 142.*
ASCE RESEARCH FELLOWSHIP:	*1960 award closes March 15, 1960. See Official Register, page 156.*

ASCE Prizes and Awards Are Announced by Board

On recommendation of the Committee on Society Prizes, the Board at its Cleveland meeting approved the following awards for papers published in Volume 123 (1958) of Transactions and in CIVIL ENGINEERING. The prizes will be presented during the Society's Annual Convention, to be held in Washington, D. C., this October. Brief biographies and photos of the winners are scheduled for the October issue.

Membership designations are shown as they appear in the official action, rather than as changed on June 6.

Norman Medal

WILLARD J. TURNBULL, and CHARLES R. FOSTER, Members ASCE, for Paper, "Stabilization of Materials by Compaction."

J. James R. Croes Medal

CHARLES I. MANSUR, M. ASCE, and ROBERT I. KAUFMAN, A.M. ASCE, for Paper, "Pile Tests, Low-Sill Structures, Old River, Louisiana."

Arthur M. Wellington Prize

FRANK H. NEWNAM, JR., M. ASCE, for Paper, "Developing Port Facilities on Houston's Ship Channel."

Thomas Fitch Rowland Prize

J. GEORGE THON, M. ASCE, and GORDON L. COLTRIN, A.M. ASCE, for Paper, "Morro Bay Steam Electric Plant."

James Laurie Prize

BRAMLETTE MCCLELLAND and JOHN A. FOCHT, JR., Associate Member ASCE, for Paper, "Soil Modulus for Laterally Loaded Piles."

Collingwood Prize for Junior Members

NORMAN H. BROOKS, A.M. ASCE, for Paper, "Mechanics of Streams with Movable Beds of Fine Sand."

On recommendation of the Technical Divisions, the Board approved the following awards:

Rudolph Hering Medal

DONALD J. O'CONNOR, A.M. ASCE, and WILLIAM E. DOBBINS, M. ASCE, for Paper, "Mechanism of Reaeration in Natural Streams."

Karl Emil Hilgard Hydraulic Prize

EMMETT M. LAURSEN, A.M. ASCE, for Paper, "Sediment-Transport Mechanics in Stable-Channel Design."

Thomas A. Middlebrooks Award

F. E. RICHART, JR., M. ASCE, for Paper, "Analysis for Sheet-Pile Retaining Walls."

Leon S. Moisseiff Award

ALFRED L. PARME, A.M. ASCE, for Paper, "Shells of Double Curvature."

Rickey Medal

JAMES P. GROWDON, M. ASCE, for Papers No. 1742, 1743, 1744 "and also important contributions over many years to progress in hydroelectric engineering."

J. C. Stevens Award

NORMAN H. BROOKS, A.M. ASCE, for his discussion of his Paper, "Mechanics of Streams with Movable Beds of Fine Sand."

Construction Engineering Prize

EDWARD E. WHITE, M. ASCE, "Deep Foundations in Soft Chicago Clays," CIVIL ENGINEERING, November 1958.

On recommendation of the Ernest E. Howard Award Committee, the Board also approved the following award:

Ernest E. Howard Award

DAVID B. STEINMAN, M. ASCE, "for his signal contribution towards the advancement of bridge analysis and design, to the theory of the suspension bridge and its aerodynamic stability, and especially for his outstanding work in the design of the Mackinac Bridge."

EJC Backs Cabinet-Level Engineering Department

Engineers Joint Council, representing more than a third of the nation's engineers, solidly backed the creation of a Cabinet-level Department of Science and Engineering, in a statement before the Subcommittee on Reorganization and International Organization of the Senate Committee on Government Operations at a Washington hearing on April 16. EJC was represented at the hearing by Enoch R. Needles, president, and Augustus B. Kinzel, vice-president, of the organization.

"Engineers Joint Council supports in principle the creation of a Cabinet-level Department for Science and Engineering," Mr. Needles told the subcommittee, chaired by Senator Hubert H. Humphrey of Minnesota, "basically at the administrative level, the better to service our national economy and our national defense, but we would emphasize that science and engineering, directly pertinent to the missions of certain departments, must continue to be carried out within these departments."

Mr. Needles condemned the indiscriminate use of what he called a "restrictive word," that is, "technology" and deplored

it as a substitute for the word "engineering."

"We strongly urge that any administrative development in this field be properly identified as 'Science and Engineering,' not only as a matter of recognition, but also as a matter of clearly setting forth the intent of the measures to include the field of engineering activities. Our recommendation," he continued, "has far broader implications than one based on a concern for semantics. We fear that much of the planning in government has failed to properly consider this implication and we take exception to the undue emphasis on 'science,' even when used in the broad sense. Although the intent may be to include engineering, this is only apparent to those using the word and not to their audiences."

He cited engineering as "a profession in which a knowledge of mathematics and natural sciences gained by study, experience and practice, is applied with judgment to develop ways to utilize economically the materials and forces of nature for the progressive well-being of man."

Mr. Needles advocated a Department of Science and Engineering which would have not only responsibility, but the authority to act as well. He pointed out to the subcommittee that activities in science and engineering have progressed and are progressing so rapidly that new demands are constantly being made of government, industry, and higher education, and that engineering activities have widened to a point where responsible leadership in government is needed to bring about an efficient and fully developed long-range program for science and engineering.

The EJC statement concluded that the proposed department should bring together the activities of a broad engineering and scientific nature not directly pertinent to the missions of other departments. In addition, it should coordinate science and engineering in such departments by some such device as the recently established Federal Council for Science and Technology, in order to insure the development of balanced programs, prevent dissipation of effort, and insure the preservation of our excellence in the fundamental areas of science and engineering.

ASCE Commends Student Chapter Work

President Friel has announced the annual awards to Student Chapters for superior work during 1958. Fifteen Student Chapters have been awarded Certificates of Commendation, and 51 Chapters have been honored with Letters of Honorable Mention. Chapters winning Certificates for their outstanding work are:

North Central Region
Kansas State College
South Dakota State College
Missouri University

Middle Atlantic Region
University of Maryland
University of Cincinnati
Carnegie Institute of Technology

Northeastern Region
The Cooper Union
Manhattan College
University of New Hampshire

Southern Region
Virginia Military Institute
Georgia Institute of Technology
Texas Technological College

Western Region
University of Utah
State College of Washington
University of Arizona

The Letters of Honorable Mention commending Chapters for their excellent work have been awarded to the following schools:

North Central Region
University of Nebraska
University of Wisconsin
Missouri School of Mines and Metal.
Washington University
University of Kentucky
Michigan School of Mines and Tech.
Illinois Institute of Technology
University of Illinois (Navy Pier Branch)
Oklahoma University
Marquette University
Northwestern University

Middle Atlantic Region
Bucknell University
University of Delaware
University of Detroit
Michigan State University
Ohio Northern University
Pennsylvania State University
Villanova University
University of Akron
Fenn College

Northeastern Region
Brown University
University of Maine
Massachusetts Inst. of Technology
University of Massachusetts
Newark College of Engineering
Northeastern University
Norwich University
University of Vermont

Southern Region
Alabama Polytechnic Institute
Texas Western College
University of Tennessee
Duke University
Texas A & M College
Clemson College
University of Florida
North Carolina State College
Southwestern Louisiana Institute
Howard University
Tulane University
University of Virginia
The Citadel

Western Region
University of Colorado
Oregon State College
Utah State College
University of Washington
Montana State College
University of Nevada
Colorado State College
University of Idaho
University of Southern California
San Diego State College

Three Certificates are authorized for award by the President in each of the five geographical regions into which the 134 Chapters, two evening divisions, and four branch Chapters are divided for administrative purposes. The Committee on Student Chapters has devised a formula which is used to determine the number of Letters of Honorable Mention.

Enthusiasm in Chapter programs and increased understanding of the purpose of the Chapters are evident in the keen competition for these annual awards. Active participation in Chapter work leads to equally lively participation in Local Section activities after graduation. Congratulations to the Chapter members responsible for the 1958 awards.

ASCE Membership as of May 8, 1959

Members	10,513
Associate Members	15,037
Junior Members	17,099
Affiliates	83
Honorary Members	42
Total	42,774
(May 9, 1958	40,964)

The Younger Viewpoint

This month Walter D. Linzing, committee member from Zone III, is reporting.

Letters have been coming in from all points of the compass. Letters have also been going out—to all 26 Local Section presidents in Zone III. These have produced some very encouraging results and support for the "Younger Viewpoint." So far, the following Local Sections have answered, announcing their cooperation: Central Illinois, Illinois, Kansas, Kansas City, St. Louis, Wisconsin, and Oklahoma. These Sections reveal some interesting insights into ASCE Local Section operation and younger member activity. All Sections incidentally are emphasizing collections for the United Engineering Center.

Committeman Attitudes—Wisconsin Section

The Wisconsin Section calls on appointees to committees to "accept your appointment as a responsibility and as a challenge to improve yourself and ASCE. The committees are the lifeline of ASCE, and it is through your activity in these fields that you will derive personal satisfaction and professional prestige." Well put, don't you think? Incidentally there are 24 committee members on the Wisconsin *Junior Activities Committee* headed by Jack Schumacker. How many younger members are on committees in your Section? The Wisconsin Section also has a transportation coordinator in Madison to assist Madison members in forming riding pools for attending Milwaukee meetings. Perhaps other Sections can follow this lead to build up attendance at meetings some distance from home-base. . . . At a recent meeting a guest speaker noted that, "Engineering is now the only major profession limited to a four-year curriculum." Suggestions were made to increase the curriculum to five or six years by Prof. Edwin Gaylord, of the University of Illinois, the visiting speaker. What do our younger members think about this?

Younger Viewpoint Impact—Kansas Section

The president of the Kansas Section, C. Frank Virr, quoted from the January 1959 "Younger Viewpoint" article in the Section's April newsletter. Mr. Virr's interest was caught by the discussion on the engineer's duty as a citizen—should an engineer commit himself on public issues on which he is better informed than the public-at-large. . . . The Kansas University Student Chapter is talking up ASCE membership to its graduating seniors. What is being done in other parts of the country to encourage new graduates to join ASCE?

Younger Member Attitudes

ASCE Director Howard F. Peckworth, of Chicago, is concerned about some of the attitudes he has found prevalent during his term of office, especially among the younger members of the Society. He states, "I am concerned that so few of the younger men discuss technical papers, so few take an active participation in Technical Division affairs, so many complain about what they think the professional society should do for them while at the same time they expect to put little or no time and energy into the professional society." Any rebuttals, younger members? How do you measure up? Are some of our older members guilty of the same sins? Is it really just the younger members?

Idearama

In discussing what interests younger engineers and what *you* would like to see in *this column*, a potpourri of ideas has developed. They are presented here as suggestions to the direction that the "Younger Viewpoint" should take in the future:

Engineering Education. Dick Meagher and others in Chicago feel that opinions on education would be interesting. Should the new graduate pursue advanced degrees? What are the relative merits? Has college training been adequate, too general, too specific? Should the curricula be changed? Should obtaining a degree require five or six years? Dick feels that students out of school up to five or six years would be interested in some of these discussions. Engineering educators might be interested in knowing how graduates evaluate the training they have received. Incidentally, we understand that the AMA requires its members to take a refresher course or the equivalent thereof every two years.

Prestige of Younger Members. Nick Hernandez and Hans Hasen, also of Chicago, feel that younger members suffer from not being known well enough for their achievements. The "Younger Viewpoint" could publicize some of the outstanding work of younger members. Outstanding research and other successful achievements of younger members might serve as an incentive to others.

References. Specific civil engineering subjects of very special interest could be reviewed, discussed, or possibly simply listed from time to time to add technical interest to the page, Nick Hernandez suggests.

Work Experience. Young engineers would certainly like to hear the experiences of other young engineers in moving about the country, Jack C. Jones of the Illinois Section, agrees. How does a Northerner like working in the South and vice versa. The pros and cons of construction, consulting work, or governmental assignments would make interesting reading.

Miscellaneous Opinions

If engineering management were to sponsor trips of younger members to ASCE meetings as was suggested some time back in the "Younger Viewpoint", the fear is that all ASCE members would want to go to the meetings which would cost a company too much time and money. . . . ASCE should hold design seminars at both local and national level once or twice each year. . . . The "Younger Viewpoint" serves no real purpose for ASCE. . . . ASCE will not change unless and until younger men take a more active interest in the Society. If it's change you are looking for, you are the best one to bring about the change you seek. . . . How about some of your opinions?

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Montana Section Host to Pacific Northwest Council

The Montana Section was host to the Pacific Northwest Council's eleventh annual meeting, April 23-25, following a two-day Local Section Conference in Helena. Delegates from ten states took part in the three-day program, devoted to the theme, "New Horizons in Civil Engineering."

Dean C. Gillespie, Montana chief engineer for the Mountain States Telephone and Telegraph Company, spoke to a technical session on the new techniques and tools developed by Montana Telephone engineers while helping to build the nation's space age electronic defense system—the distant early warning defense radar (DEW) line in the Arctic and the SAGE (semi-automatic ground environment) line through northern Montana. This work is underway.

ASCE Past-President Mason G. Lockwood, in a featured luncheon meeting talk, warned against what he called "old fashioned engineering processes" that are driving engineering improvements underground and driving competent men from the profession. It is up to the Society and the profession, he said, to spread the understanding that "a thoroughgoing job of original engineering—whatever the costs—is in the interests of economy." Dr. A. A. Bates, vice-president of the Portland Cement Association, spoke on the need for new energy sources at the final banquet, which was attended by 150 members and wives. The Council meeting wound up with a field trip to the Anaconda Company's Open Pit Mine in Butte, Mont.

Jack Y. Barnes, a Helena engineer, was elected chairman of the 1960 Pacific Northwest Council. Mr. Barnes, who is district engineer for the Portland Cement Association, succeeds Holly Cornell, of Corvallis, Ore. Other new Council officers are Harold Sitts, of Tacoma, Wash., who was elected vice president, and Richard M. Arenz, of Helena, who will be the new secretary-treasurer of the Council. Leland J. Walker, of Great Falls, Mont., is president of the Montana Section.

The Tacoma Section will be host for the 1960 Pacific Northwest Council Conference, in Tacoma, Wash.

The Montana Section played host to the Pacific Northwest Council of ASCE in Helena, April 23-25. The program included the election of new Council officers who will take office in July. Pictured, in usual order, are Holly Cornell, president; Oliver Domries, secretary-treasurer; Harold Sitts, vice-president elect; Jack Y. Barnes, vice-president and president elect; and Richard Arenz, secretary-treasurer elect.

At North Central Conference of Student Chapters, held in Detroit this spring, Otis Gouty (left), Assistant to the Secretary of the Society, presents—for the fourth straight year—the Man-Mile Trophy to Robert Blank, president of the Ohio Northern Student Chapter. The trophy is awarded annually to the Chapter which accumulates the most man-miles in attendance at the conference.

ASCE CONVENTIONS

ANNUAL CONVENTION
Washington, D. C.
Hotel Statler
October 19-23, 1959

NEW ORLEANS CONVENTION
New Orleans, La.
Jung Hotel
March 7-11, 1960

RENO CONVENTION
Reno, Nev.
June 20-24, 1960

TECHNICAL DIVISION MEETINGS

HYDRAULICS CONFERENCE
Fort Collins, Colo.
Colorado State University
July 1-3, 1959

Sponsored by
ASCE Hydraulics Division
Colorado Section
Colorado State University

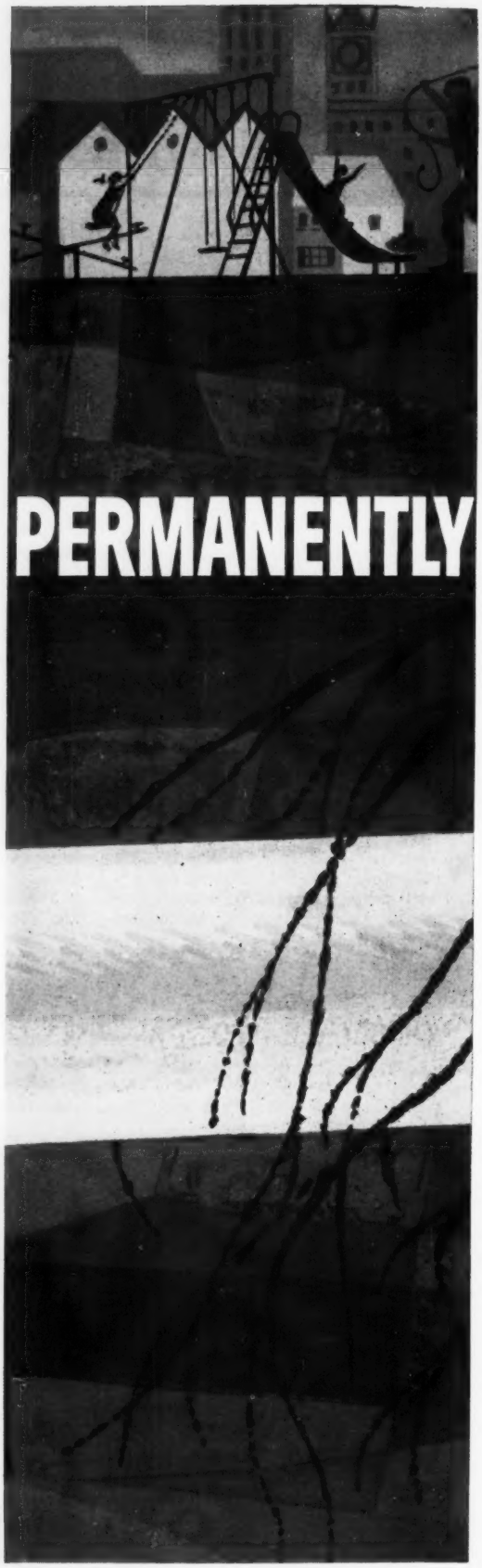
IRRIGATION AND DRAINAGE CONFERENCE
Denver, Colo.
Albany Hotel
August 27-29, 1959

Sponsored by
Irrigation and Drainage Division
American Meteorological Society

SIXTH MIDWESTERN CONFERENCE FLUID AND SOLID MECHANICS
Austin, Tex.
University of Texas
September 9-11

Sponsored by
Engineering Mechanics Division

K&M ASBESTOS-CEMENT SEWER PIPE



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Flow-stopping, pipe-clogging roots . . . no matter how cobwebby-thin . . . can't penetrate the exclusive patented "K&M" FLUID-TITE coupling . . . unmatched in its tight sealing. In repeated tests, "K&M" Asbestos-Cement Sewer Pipe successfully resisted infiltration even when external water pressure was 25 psi . . . the equivalent of a 58-foot head and way above field conditions.

Service remains continuous and uninterrupted . . . with fewer inspections and periodic cleanings. You can reduce treatment loads and costs . . . because infiltration is eliminated. Being made of quality asbestos fibers and portland cement, "K&M" Sewer Pipe does not corrode and is immune to electrolysis.

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8	1500	2400	3300		
10	1500	2400	3300	4000	5000
12	1500	2400	3300	4000	5000
14	1500	2400	3300	4000	5000
16	1500	2400	3300	4000	5000

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BEST IN ASBESTOS

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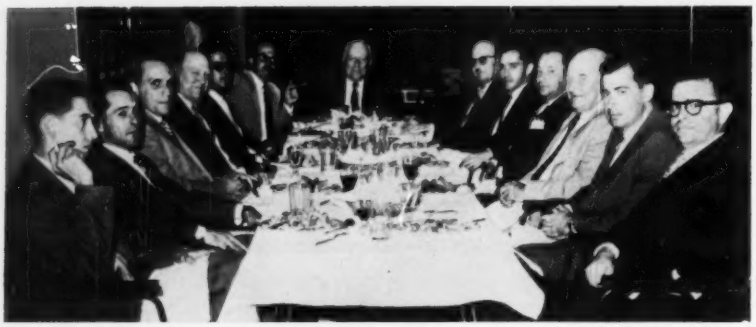
Brother B. Austin Barry (right), Metropolitan Section secretary and associate professor of Civil Engineering at Manhattan College, was guest speaker at the National Capital Section's annual dinner in March. His talk, "Dawning of a New Day in Engineering," was concerned with the need for adjustments in engineering curricula to meet the pace of modern engineering developments. ASCE President Francis S. Friel (left), presented Life Membership Certificates at the dinner, while Section President Alfred R. Golze presided.



Republic of Colombia Section members in Medellin, Colombia, recently held a dinner to honor ASCE Past-President Gail A. Hathaway, Lorenz G. Straub, and Robert N. Allen, who were in South America as consultants on water resources development projects. Section members and their honored guests are, in usual order, Luis G. Restrepo, Dario Restrepo-Tobon, Luis J. Aristizabal, Lorenz G. Straub, Josue Gutierrez-Villegas, Jose Tejada-Saenz, Gail A. Hathaway, Gustavo Mesa-Arango, Oscar Mejia Vallejo, Hernando Cadavid, Robert N. Allen, Adolfo Arango-Montoya, and Bernardo Jaramillo-Betancur.

The eleventh annual meeting of the District 10 Council was held in Charlotte, N. C., April 10-11, with the North Carolina Section as host and delegates present from all eight member Sections. The group included (seated, left to right) Irving W. Tourtellot, secretary-treasurer, District 10 Council; Thomas P. Noe, vice-president, North Carolina Section; Paul L. Holland, ASCE Vice-President, Zone II; James F. Pou, chairman, District 10 Council; Louis R. Shobe, president, Knoxville Branch, Tennessee Valley Section; Hendon R. Johnston, president, Tennessee Valley Section; Don H. Mattern, ASCE Director, District 10; John D. Watson, North Carolina Section; Francis E. Pray, Tennessee Valley Section; Thomas H. Freeland, Georgia Section; Carl E. Kindsvater, Georgia Section; Charles D. Durfee, Tennessee Valley Section; James F. Shivler, Florida Section; Franklin Pitcher, secretary-treasurer, Tennessee Valley Section; Albert E. Johnson, secretary-treasurer, South Carolina Section; and James M. Faircloth, Alabama Section. Standing, in same order, are Howard M. Post, vice-president, Miami Section; John E. Bing, president, Georgia Section; Marcus B. Hunder, president, South Carolina Section; Robert O. Harris, Georgia Section; Edward M. Dougherty, president, Nashville Section; W. S. Eisenberg, president, Jacksonville Branch, Florida Section; and Cecil F. DeVilbiss, Nashville Section.

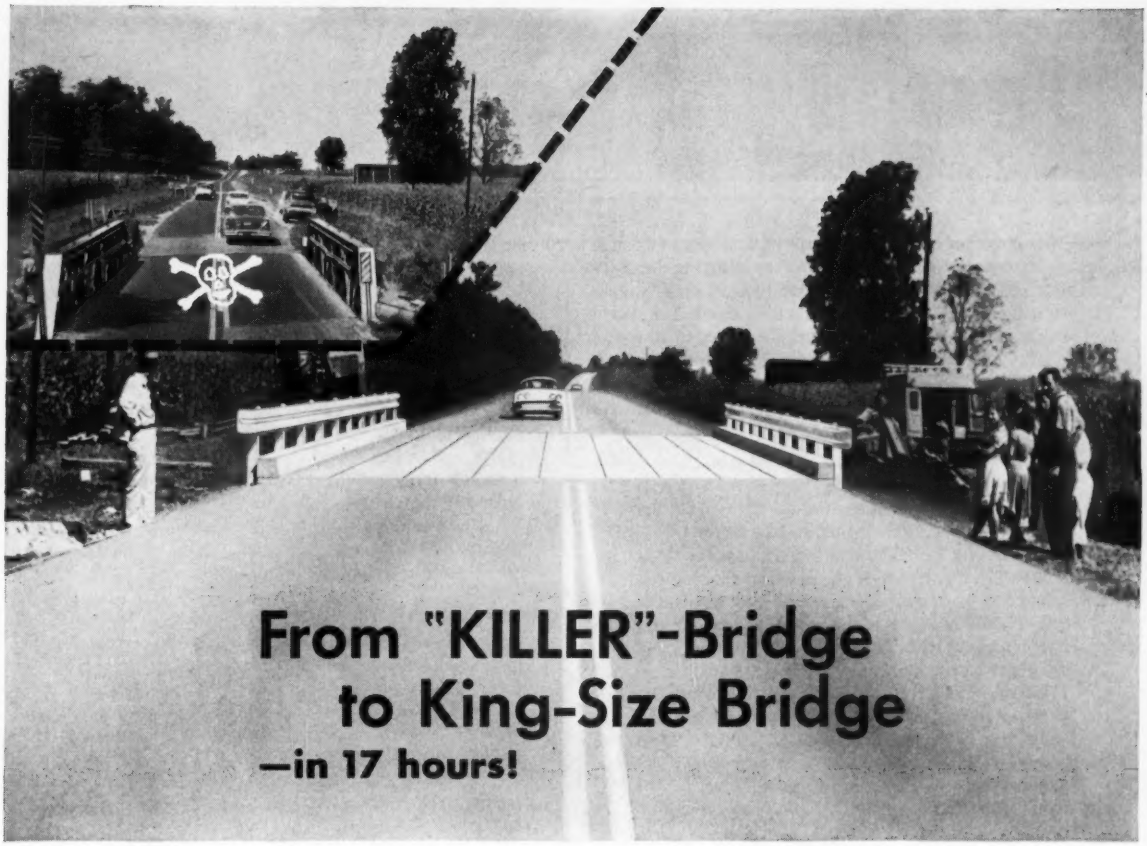
Mohawk-Hudson Section Host to District 3 Conference

Districts 1, 2, and 3 were represented at a recent Local Section Conference held in Albany, N. Y. The 25 delegates taking part in the two-day program concentrated on problems common to the eleven Local Sections and two Branches represented. The Mohawk-Hudson Section and District 3 Council were hosts to the group.

Those attending the conference were urged by Harold Bateson, of the Rhode Island Section, to plan their programs well in advance and to provide the best possible speaker for each meeting subject. Mr. Bateson supplied the delegates with a program guide outlining the various steps that will result in effective programs. A dominant conference theme was the need for more and better public relations at Local Section level. M. O. Chenoweth, director of public relations for ASCE, told the delegates that ways of achieving better publicity include arranging programs of strong local interest and featuring prominent local speakers.

Other subjects of mutual concern included good policy in management of Section finances, advantages of continuity in Local Section government, working relations with local groups of other professional and technical societies, and developing a feeling of "belonging" among young engineers.

At a meeting of the District 3 Council following the conference, the groundwork was laid for a New York Council, which would encompass District 3 and the Metropolitan Section.



with AMDEK Concrete Beams

Only 17 hours were required by the Indiana State Highway Department to eliminate a deadly old "Killer" Bridge and replace it with a modern, wide structure near Scottsburg, Indiana. This new Amdek Bridge is not only safer to cross but is constructed of maintenance-free concrete.

American-Marietta Company makes precast concrete beams for spans up to 36 feet and prestressed beams for longer spans. All are economical and made under factory-controlled conditions—delivered to the job quickly from American-Marietta plants strategically located throughout the nation.

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BY-LINE WASHINGTON . . . . .

Congress has ordered the Corps of Engineers (through its Rivers and Harbors Board) to start preliminary work on what will be the biggest hydroelectric project ever—the $1.5 billion development of the Yukon Basin in Alaska. The project would include a dam in Rampart Canyon, about 90 miles northwest of Fairbanks, to back up a 1.5-billion-cu ft lake, covering 10,000 sq miles. Power output would be about 5,000,000 kw.

* * *

Controversies over the use of foreign-made materials in construction projects could get worse as a result of two Washington developments:

The first is a circular memorandum issued by the Bureau of Public Roads, permitting state highway departments to limit the use of foreign-made materials in their work by requiring contractors to report their intention of using any such materials, and by figuring bids (in comparison with those using U.S. materials) with an added percentage against the foreign materials.

The second is a bill (HR 5679) to amend the 1933 "Buy American" act, which provides that only U.S. materials may be procured for public use except in areas of shortage—and says specifically that no bid on U.S. materials shall be considered unreasonable because it's higher than a foreign bid.

* * *

Whatever is done about replenishing the Highway Trust Fund—and the best bet still is that money will be borrowed, rather than taxes raised—lawmakers have this hard fact to contend with: If the 41,000-mile Interstate System is finished on schedule in 1972, it will probably cost $13 billion more than the originally estimated $26.5 billion.

The reason, according to testimony of the Bureau of Public Roads and others, is only partly rising costs of materials and labor. The big reason is the addition of many miles of road in urban areas, with attendant expensive crossings, interchanges, and the like.

* * *

Three developments relating to water resources are worth watching. Two of them affect the Great Lakes. The Senate has approved a Great Lakes Compact (a similar one was killed in the House last year), which would permit Lakes states and even Canadian provinces to coordinate construction work on the Lakes and promote joint efforts to improve water supplies, control pollution, and the like. Opening of the St. Lawrence Seaway late in April has brought immediate demands for new construction funds, including $29 million for the Corps of Engineers to improve channels in the western end of Lake Erie for deep-water shipping.

Meanwhile, the Senate also approved the formation of a Select Committee on National Water Resources, consisting of sixteen senator-members, all from the West and Mid-West, under Oklahoma's Bob Kerr. Senator Kerr has pledged that the group won't come up with any recommendations for TVA-type developments.

Of interest, also, is a fourth development—Congressman Blatnik's bill to increase grants-in-aid for pollution control works from $50 million to $100 million annually should clear the House. Its chances are considered good, since the money would come out of a revolving fund and needn't be counted in the budget.

* * *

The security-conscious Defense Department is deep in a new worry: How to get bids for missile bases without releasing enough plans and specifications to show just what's going into the base, where it is, etc. In fact, the Department has recently refused to release pictures of construction work already under way.

The problem is that the Corps of Engineers is letting contracts for missile-base construction in open bidding, in accordance with the law and long-standing practice. What worries the Pentagon is the realization that once a contractor has the specifications, a lot of his people, not security cleared, must know what's in them.

* * *

Prospects are considered poor for establishment of a cabinet-level Department of Science and Technology, as proposed in Senate Bill 676. Strong opposition by government scientific chiefs, generally under leadership of the Department of Commerce, plus Congressional reluctance to create a brand-new department, are reasons for the dim prospect. Under the terms of the bill, the new department would take over the Atomic Energy Commission, the National Aeronautics and Space Administration, the National Bureau of Standards, and some research functions of the Smithsonian Institution. Its backers include Engineers Joint Council.

* * *

Politics—and a search for a scapegoat—are behind the latest move to change the status and responsibility of the Architect of the Capitol. At present the Architect (the current incumbent is J. George Stewart, a civil engineer and former congressman from Delaware) is appointed by the President without consultation with Congress, and does not have to be a qualified architect or engineer. He is, in fact, an administrative officer, whose responsibility includes the maintenance and repair of the Capitol and certain other government buildings (there's a $100 million construction program under his control right now). Under a new bill (S 1847) introduced by Illinois' Senator Douglas, the Architect would be appointed by the president of the Senate and the Speaker of the House, and would be required to be a qualified architect.

The basic reason for the bill is senatorial dissatisfaction with the ornate new Senate Office Building, which Senators claim is badly designed, inefficient, and needlessly expensive. (Note: Mr. Stewart is said to have had no hand in planning the new building or the equally controversial Senate subway—they were handled by a Senate committee and a group of architects it employed.)

* * *

A limit on airplane sizes and weights as the most practical way to reduce ever-increasing runway length requirements could be in the offing. Brig. Gen. Marcus Cooper, assistant administrator of the Federal Aviation Agency's Office of Plans and Requirements, hinted at such action in a recent address before airport operators. Specifically, General Cooper said the FAA may refuse to certify aircraft of gross weights that require runway lengths of more than 10,500 ft.

Progress Report on STEEL CONSTRUCTION

JUNE, 1959

BETHLEHEM STEEL

BETHLEHEM FABRICATED STEEL CONSTRUCTION

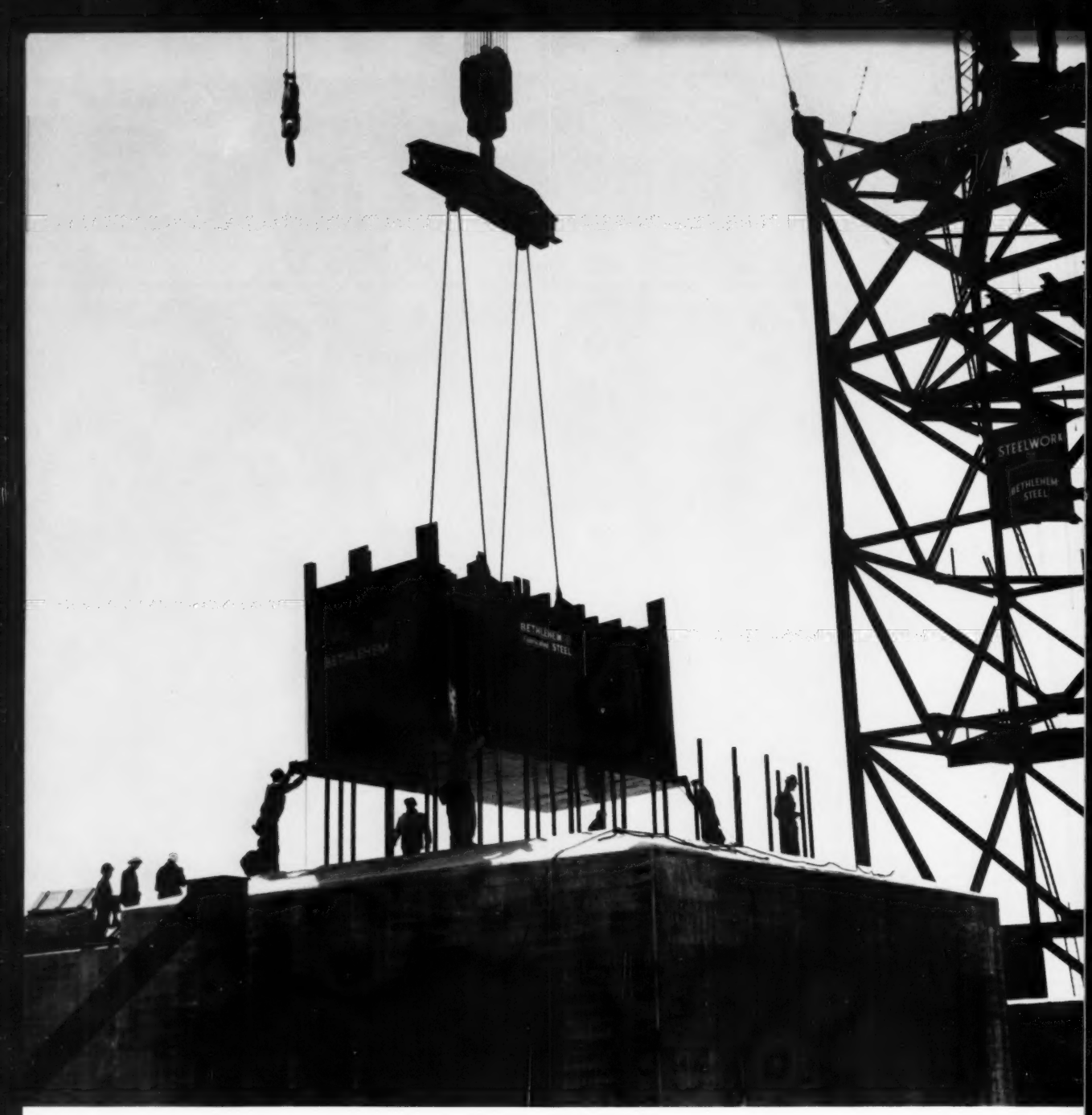
For all credits, please see last page.

They Saved the Biggest for Last

YORK HAVEN, PA.—Usually the heaviest steel members are placed near the base of a structure. Not so here. Two hefty plate girders, far and away the largest pieces in the job, had to be placed at the very top of the 170-ft-high boiler support structure of this big steam-electric generating plant. The girder you see here tipped the scales at 66 tons. The other, only 38 tons, was still a sizeable lift.

The project is Pennsylvania Power & Light Company's Brunner Island plant, on the Susquehanna River. Its cross-compound turbine generator, twice as big as any other on the PP&L system, will have an effective capacity of 300,000 kilowatts. Bethlehem fabricated nearly 3,000 tons of steel for the various structures required at the station. Our erection crews used high-strength bolts for field connections.

The Brunner Island plant will be of the outdoor type. All major equipment, including the turbine generator, is left out in the open. This means substantial construction economies with no loss in operating efficiency. PP&L's Martins Creek plant, for which Bethlehem supplied the steelwork in 1954, was the first of this type to be constructed in a northern climate. It has proven a complete success.



Easy Does It

NEW YORK CITY—Keen eyes and skilled hands guide this tricky operation, placing a 74½-ton suspension bridge tower section onto its pier. The place is the upper East River, where Bethlehem bridgemen are erecting the towers for the Throgs Neck Bridge, a project of the Triborough Bridge and Tunnel Authority.

Hoisted from a barge by a giant tower derrick, 100 ft high, the section was carefully positioned and lowered onto fourteen anchor bolts, each 3 in. in diameter, and extending 5½ ft from the concrete pier. The operation was then repeated, each tower requiring four such sections, two for each leg.

When the bridge is completed, the load on each tower at its base will be 50 million pounds. The towers will rise 336 ft above the piers, which in turn have an elevation of 23½ ft.

The main span will be 1,800 ft. In general the design is similar to that of Philadelphia's Walt Whitman Bridge, completed by Bethlehem in 1957.

BETHLEHEM STEEL

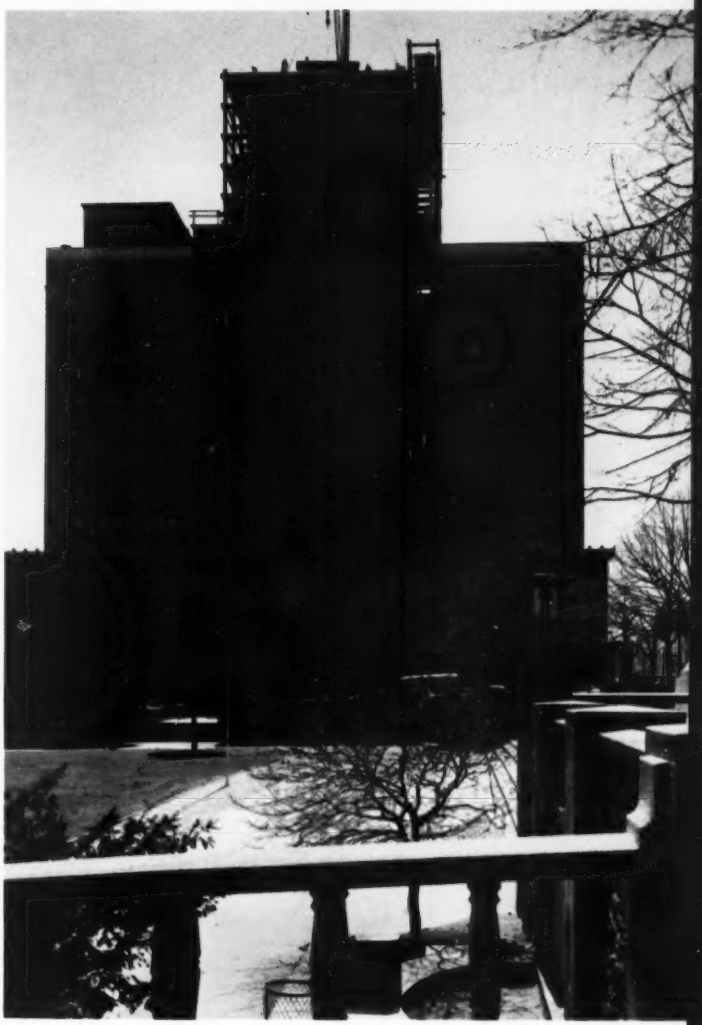
Here's an Unusual Building Addition

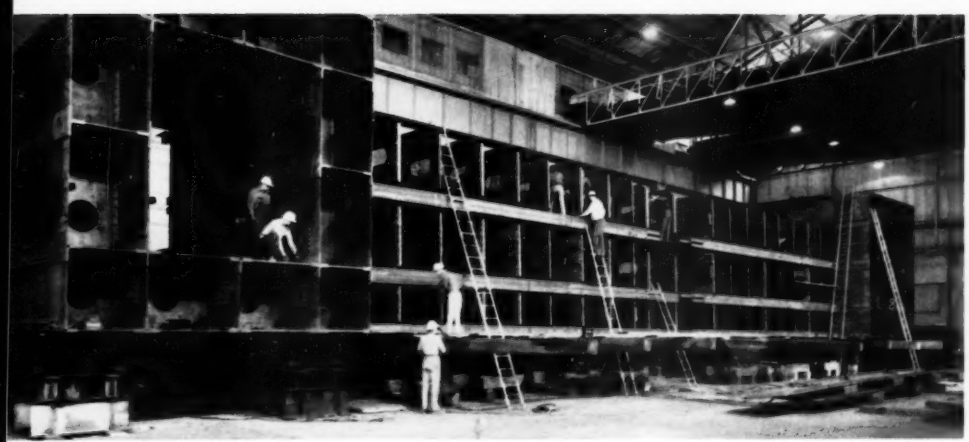
WILMINGTON, DEL.—Sturdy as its name implies, the Hercules Tower rises above the wings of the Delaware Trust Building that nearly surround it. Now topped out, the tower stands twenty-two stories plus penthouse, and is by far the tallest building in the city.

Its erection was unique, involving problems rarely encountered in multi-story construction. First was the difficulty of maneuvering all of the steel through a 14-ft alley, the sole means of access to the job. Second came the problem of placing giant plate girders just 2½ in. above the roof of a one-story building that remained in full operation while the tower was erected above it! Finally, the entire tower had to be erected without so much as breaking a window in the Trust Building only scant feet away, and with minimum disturbance to office workers.

Despite these demanding requirements, Bethlehem erection crews accomplished the job, and fast. They used high-strength bolts, a Bethlehem product that has become virtually standard for field erection.

Unlike the Atlanta telephone company addition described in these pages, the Hercules Tower is not tied in structurally with the original building, although access is provided between the two at every floor level.





Pre-assembly of tower portal at the Pottstown Fabricating Works.

BETHLEHEM STEEL

Iowa-side bridge approach.

An addition—and then some

LOS ANGELES—When The Standard Federal Savings and Loan Association headquarters was built in 1953 it was one of the city's first post-war, thoroughly modern commercial buildings. Its steel framework was completed by Bethlehem Pacific crews in the speedy time of only 29 working days.

Now the fast-growing Association requires greatly increased office space. So Bethlehem Pacific was called upon to put up this 13-story addition, again in jig time. It's 195 ft high, and provides 128,000 sq ft of floor space.

While the two buildings will be fully integrated, they are designed to move independently in the event of seismic disturbances. The slight gap provided between the structures is bridged by standard expansion joints in the connecting floors, walls, and ceilings.

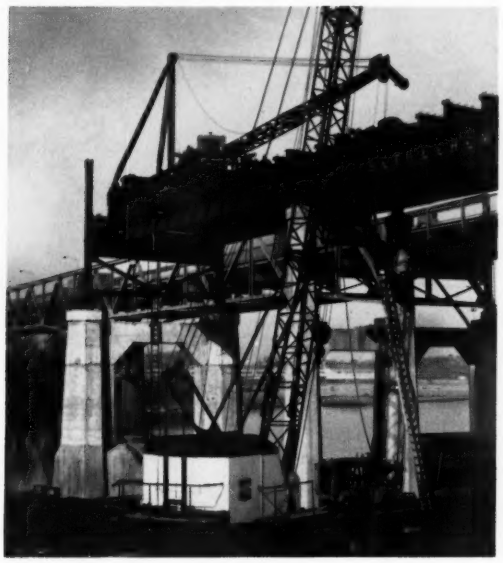
They're Bridging the Mississippi Again

BETTENDORF, IOWA—Bethlehem bridgemen put the finishing touches to the Iowa-side approach steel for the new Iowa-Illinois Memorial Bridge over the Mississippi River between this city and Moline. It's a most unusual job in that the new bridge will be virtually identical to the existing bridge, constructed in 1935 by McClintic-Marshall Corporation, then a Bethlehem subsidiary. The two bridges will be only 73 ft apart, center-to-center, as is apparent in the photos at left and below.

The new bridge will extend 5,017 ft, of which 3,370 ft is over water. Its most spectacular portion is the suspension bridge. Its towers will rise 160 ft above water level, with a main span of 740 ft, and side spans of 370 ft each. Bethlehem is handling all phases of erection including supplying and spinning the suspension cables.

The approaches on the shorter Iowa side comprise fifteen continuous beam spans, totaling about 900 ft. Starting from the Illinois side of the river, there are eleven continuous beam spans for 747 ft, then six through-truss spans and a single deck-truss span for a total length of 1,498 ft.

The Davenport Bridge Commission plans to change traffic flow, upon completion of the new bridge, to one-way traffic on each. This arrangement will be flexible, and can be revised to meet the requirements of fluctuating traffic conditions.



Illinois-side approach.

LA's First 'Scraper

LOS ANGELES—This is the topped-out framework for the California Bank at Sixth and Spring streets, the first downtown commercial building to exceed the former height limit. It's 267 ft high, well above the previous restriction of 150 ft.

Actually there are sixteen floors to be used for commercial purposes, the seventeenth and eighteenth floors housing building services. There are four underground levels, providing parking space for some 245 cars.

Bethlehem Pacific handled fabrication and erection, using high-strength bolts for field connections.

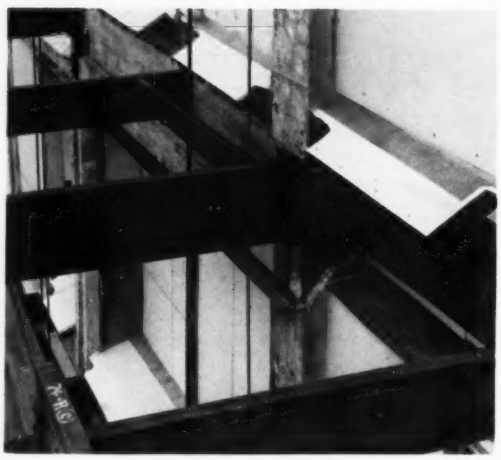
Steel Buildings Can Grow—and Grow!

ATLANTA—If you want evidence of the expandability of a steel-framed building, here it is. Back in 1929, Southern Bell Telephone and Telegraph Company constructed a six-story, steel-framed, limestone-faced equipment building at 51 Ivy Street. By 1946 the city's need for telephone service had grown to the extent that the company added eight stories to provide more space, bringing the height of the building to fourteen stories. Bethlehem Steel crews handled the addition so as not to interfere with normal operation of the lower floors.

Again this year the building is growing, this time horizontally, and once again Bethlehem is on the job. To the rear of the main building they're adding a 126 by 111-ft structure, four floors and mezzanine, with two basements. Furthermore, this framing is designed to be extended to fourteen stories when future requirements demand it.

In the words of Southern Bell, "Atlanta's importance as a communications hub of the South—one of the largest long distance switching centers in the world and one of the three major TV control centers—will be further increased when the project is completed."

As can be seen in the photograph, the existing brick walls were removed and temporary dust-proof, fire-proof, and moisture-proof partitions were installed. The steel columns were exposed and clips and seats bolted or welded to them. As new beams are bolted to these connections, the two buildings become tied-in structurally.



Detail of connections to existing framing.

The addition, totaling about 1,330 tons, is being erected with high-strength structural bolts for speed, quietness, safety, and economy. As can be seen, holes were drilled in the tops of the columns to facilitate construction of the future upper floors.

BETHLEHEM STEEL

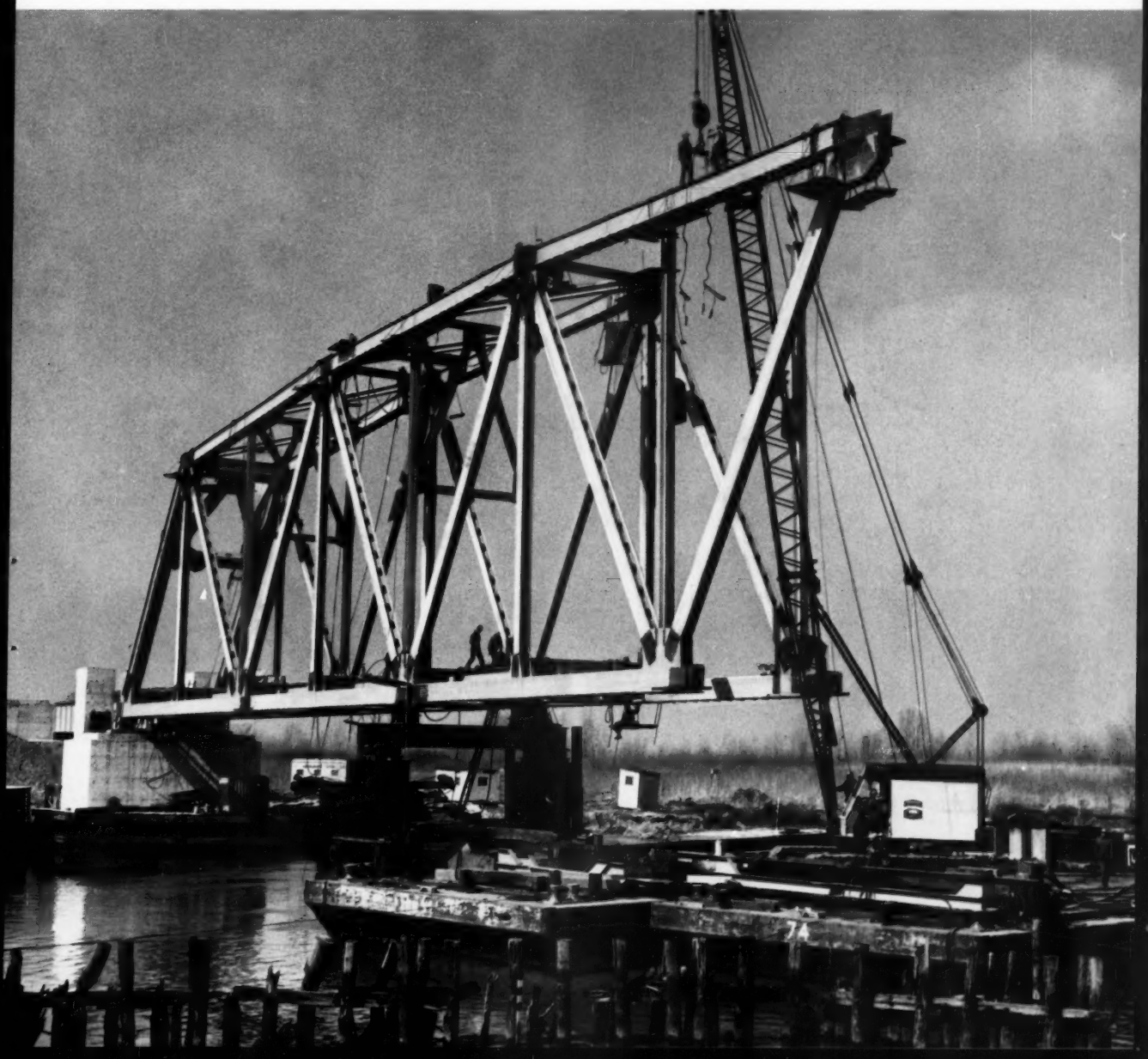
BETHLEHEM STEEL

Channel Crossing

CALUMET CITY, ILL.—Here's a bridge that required considerable ingenuity in its erection scheme. The primary problems facing Bethlehem erection crews were the through-truss design of the main bridge, which limited the type of equipment that could be used, and the necessity of keeping the main channel of the Little Calumet River open for navigation.

The single-track railroad bridge, comprising two 67-ft deck-plate girder approaches and a 310-ft Warren truss main span, is being built for the Michigan Central Railroad of the New York Central System. It replaces a nearby swing bridge, and is designed for conversion to a vertical lift bridge when other river improvements permit the passage of large vessels. The new construction is part of the Chicago District Corps of Engineers' Calumet-Sag Navigation Project.

First, Bethlehem bridgemen erected the west side girder approach. Meanwhile, they mounted a 50-ton-capacity crawler crane on a barge tied to another barge on which they erected two falsework bents. The first four panels of the truss were assembled on the bents, then floated into place so as to rest on the west abutment and a falsework bent placed in the river 124 ft from shore. From this falsework they cantilevered two more panels out across the navigation channel, using the floating crawler. To avoid obstructing navigation any longer than necessary, they didn't install the second falsework bent until that cantilever was complete. Then, with the falsework in place, they cantilevered the final four panels the remaining 124 ft to the east abutment.



CREDITS . . .

Brunner Island Steam Electric Station	*Owner:* Pennsylvania Power & Light Company; *consulting engineers:* Ebasco Services, Inc.; *contractor for boiler and boiler supporting structure:* Combustion Engineering Inc.
Michigan Central Railroad Bridge	*Owner:* New York Central Railroad Company; *consulting engineers:* Howard Needles Tammen & Bergendoff
Hercules Tower	*Owner:* Shapdale Inc.; *architect:* W. Ellis Preston; *structural engineers:* Severud-Elstad-Krueger Associates; *general contractor:* Wark & Company
Telephone Building Addition	*Owner:* Southern Bell Telephone and Telegraph Company; *architects and engineers:* Saggus, Williamson, Vaught and Spiker; *general contractor:* Barge-Thompson, Inc.
Iowa-Illinois Memorial Bridge	*Owner:* Davenport Bridge Commission; *design engineers:* Modjeski & Masters (Modjeski, Masters & Case, Inc., designed the existing bridge)
Throgs Neck Bridge	*Owner:* Triborough Bridge and Tunnel Authority; *consulting engineers for main bridge:* Ammann & Whitney; *consulting engineers for approach viaducts:* E. Lionel Pavlo; *consulting architects:* Aymar Embury II, A. Gordon Lorimer, John B. Peterkin, Theodore J. Young
California Bank	*Architect and engineers:* Claud Beelman & Associates; *consulting structural engineers:* Brandow & Johnston; *general contractor:* C. L. Peck Construction & Realty Company; *interior floor design:* Henry Dreyfuss
Standard Federal Savings & Loan Association Building	*Architect:* Welton Becket and Associates; *structural engineer:* Donald Douglas; *general contractor:* C. L. Peck Construction & Realty Company

NEWS BRIEFS . . .

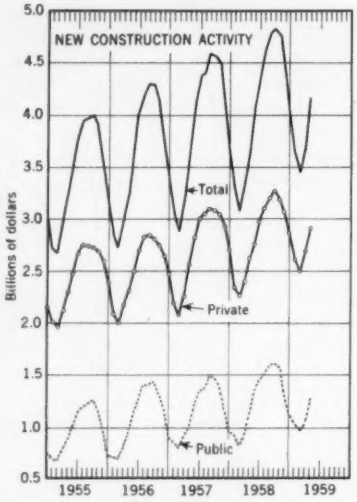
Construction Activity Expands in April

New construction activity expanded seasonally in April, bringing the total value of work put in place to new highs of $4.2 billion for the month, and $15.1 billion for the January-April period, according to preliminary joint estimates of the U.S. Departments of Labor and Commerce. This year's April figure was up 15 percent from 1958, and the total for the first four months was 13 percent greater. Spending for new construction thus far in 1959 is at a seasonally adjusted annual rate of $54.3 billion, compared with actual outlays of $49.0 billion for the entire year of 1958.

Private expenditures for new construction in the January-April 1959 period reached a record $10.7 billion, mainly because of a 29 percent advance in residential building (to $6.1 billion) over the early months of 1958. Some types of private nonresidential construction also showed strength, but office building for the first four months was off 9 percent from 1958, and industrial building outlays were at the lowest January-April level since 1951.

Public construction expenditures through the end of April 1959, at $4.4 billion, were 17 percent above the first four months of 1958. The gain came chiefly from expanded activity in highways, housing, and military construction, though there were also over-the-year advances on most other types of public projects.

The monthly estimates of the joint agencies are determined primarily by past contract award movements, standard progress patterns, and assumed normal seasonal movements. Except when special surveys are made, the estimates do not reflect the effects of varying numbers of working days in different months, nor of special conditions influencing the volume of activity in any given month, such as unusual weather, materials shortages, overtime, work stoppages, and postponements.



Seasonal expansion of construction activity in April brings total value of work put in place to new high of $4.2 billion.

Brazil Plans Move To Its New Capital

Brasilia will become the official capital of Brazil sometime in 1960, it has been officially announced by the Brazilian Consul General in New York. Arrangements have already been made for President Kubitschek and his government, the entire diplomatic corps, and more than 6,000 federal employees to move into the new capital. It is also expected that many United States corporations will establish their South American headquarters in the handsome new office buildings that are now going up.

Called the Washington, D. C., of the twentieth century, the new capital is being built from scratch on an uninhabited plain of grassland and scrub forest halfway between the densely populated seacoast and the Amazon jungle. It is 600 miles northwest of Rio de Janeiro, the present capital.

Some 40,000 men are working in three shifts to build the city, which is being laid out in the shape of an airplane. In addition to the President's Palace and government buildings, the capital project includes a 180-suite luxury hotel, five miles of business and commercial buildings, 150 miles of paved road, and 100 miles of railroad. Last September work was started on the first 500 of a planned 2,000 low-cost houses. A dam 400 feet high and 2,000 ft long is also being built. It will impound a 24-mile-long artificial lake bordering the city on three sides.

Brasilia, which encompasses a 2,260-sq mile area, is expected to develop the rich interior of Brazil Superhighways to link it to all parts of the country are either underway or planned.

Kaiser Center Features Aluminum Curtain Wall

Aluminum as a building material is displayed to advantage in construction of the largest office building on the West Coast—the main unit of the $45-million Kaiser Center project in Oakland, Calif. This view shows aluminum curtain wall being erected on the front of the building and dolomite-embedded concrete end wall at right. Both the front and rear curve elevations of the building are being covered with an aluminum curtain wall of natural, gray, and gold aluminum alloy with tinted gray glass, fabricated and installed by the Kawneer Company. Exposed columns shown here will be enclosed in wide dark gray anodized extruded aluminum sections. More than 2,000,000 lb of aluminum will be used in the 28-story, arc-shaped structure, world headquarters of the Kaiser industrial organization. Welton Becket and Associates designed the center, and Robert E. McKee is the general contractor.

Japan to Be Host to Earthquake Conference

Japanese engineers will be host to the Second World Conference on Earthquake Engineering, to be held in Tokyo, July 11-18, 1960. At the First World Conference, held in Berkeley, Calif., in June 1956, it was decided that the next conference might most profitably be held in Japan. The conference is being organized by the Science Council of Japan, a government agency representing Japanese scientists. The Japan Society of Civil Engineers, the Architectural Institute of Japan, and the Seismological Society of Japan will cooperate with the Science Council in the organization and operation of the conference.

Papers presented will report on strong-motion earthquakes and resulting damage to structures; recent research in the general field of engineering seismology; and new developments in aseismic design and construction practice in seismic countries. In addition there will be a two-day inspection of earthquake-resistant facilities in the Kyoto area.

All papers accepted for the conference will be printed prior to the conference for distribution at the conference. The closing date for submitting papers is January 15, 1960. Papers are to be in English, and conference sessions will be in both English and Japanese.

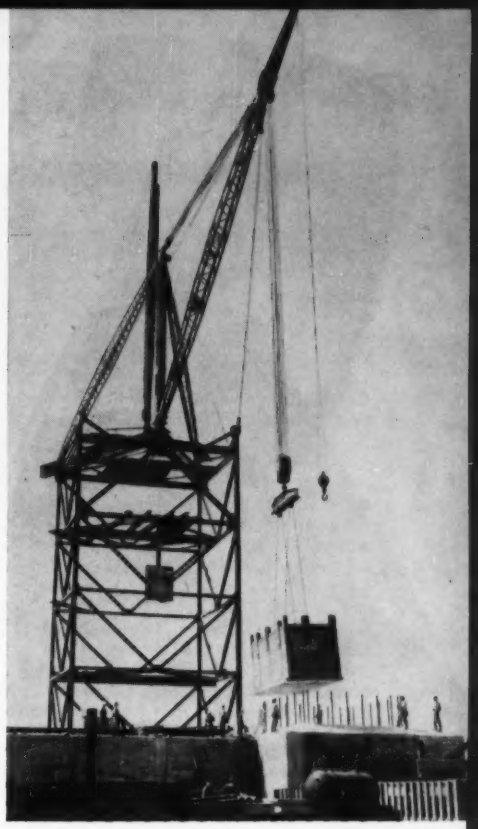
The Organizing Committee will help arrange housing and board for visitors from other countries. Inquiries should be addressed to Prof. Kiyoshi Muto, Chairman, Organizing Committee, Second World Conference on Earthquake Engineering, Science Council of Japan, Ueno Park, Taito-ku, Tokyo, Japan.

Thailand to Have New Power Station

A contract for a new semi-outdoor-type power plant, to be built in Bangkok as a major unit in Thailand's electrification and industrialization program, has been awarded to the Kuljian Corporation, Philadelphia engineers and constructors. The award, made by the Yanhee Electricity Authority, calls for the design, engineering, supervision of construction, and initial operation of the new thermal power plant. The initial installation, which will cost about $17,500,000, includes one 77,000-kw hydrogen-cooled turbo-generator and one steam generator unit. Ultimate station capacity will be three 77,000-kw units and a 270,000-kva substation.

The Yanhee Electricity Authority has obtained a $14,500,000 loan from the Export-Import Bank of Washington, which covers all power plant equipment and materials purchased in the United States. The generating equipment will be supplied by the Westinghouse Electric International Company.

First Steel Set for Throgs Neck Bridge



The $90,000,000 Throgs Neck Bridge, connecting the Bronx and Queens, moved nearer realization on May 4 when Bethlehem Steel Company crews began erecting the first of the two giant towers that will support the main suspension span. Four huge steel assemblies, each weighing approximately 73 tons, were set on a previously prepared concrete foundation 23½ ft above the waterline. These sections will be joined together to form the base for one of the two legs of the Bronx tower. The finished towers will rise 350 ft above the water. The bridge, scheduled for completion in 1961, will have a total length (with approaches) of 12,310 ft. It will be an integral link in the Interstate Highway System, connecting Long Island highways with the New York and New England Thruways. Ammann & Whitney are the engineers for the Throgs Neck Bridge, a project of the Triborough Bridge and Tunnel Authority.

Group Studies Improvement of the Panama Canal

Both short- and long-range programs for improvement of the Panama Canal were subjects of discussion on April 13 when the Board of Consultants on Isthmian Canal Studies of the Merchant Marine and Fisheries Committee of the House of Representatives met at ASCE headquarters in New York, with official representatives of the Panama Canal Company. Seated, left to right, are Francis S. Friel, President ASCE and member, Board of Consultants, Isthmian Canal Studies; Maj. Gen. W. E. Potter, F. ASCE, governor of the Panama Canal Zone and president of the Panama Canal Company; Dr. S. C. Hollister, F. ASCE, member, Board of Consultants; Howard T. Critchlow, F. ASCE, secretary to Board of Consultants; John E. Slater, member, Board of Consultants; and Dr. Hartley Rowe, member, Board of Consultants. Standing, in same order, are Roger M. Howe, Special Studies Staff, Panama Canal Company; John D. Hollen, chief, Executive Planning Staff, Panama Canal Company; Bernard J. Zincke, board contact with Committee on Merchant Marine and Fisheries; Maurice N. Quade, F. ASCE, senior partner, Parsons, Brinckerhoff, Hall & Macdonald; and Lt. Col. Robert D. Brown, Jr., engineering and construction director, Panama Canal Company.

Russian Education System Good—But "Not For Us"

Engineering education in the Soviet Union is of good quality, but this does not imply that the Soviet system of education should be "emulated by us," engineers attending the Cleveland Convention were told. This is because of the high degree of specialization and standardization of engineering education in Russia, Ralph Fadum, F. ASCE, head of the Department of Civil Engineering at North Carolina State College, said.

In 1958 Professor Fadum was in Russia as a member of an engineering education mission composed of eight leading American engineering educators. The mission was initiated by the U.S. Department of State under an agreement with the USSR for the exchange of scientific and cultural personnel. The U.S. delegation visited twenty-five educational institutions in a 6,000-mile circuit.

Specialization in Russian engineering education is at such a high level that the curricula are designed to prepare students to be immediately useful to industry with a minimum of additional training, Professor Fadum said. The Soviet system is to produce engineers to fit the needs of industry. This means the Russian student is not prepared to take advantage of a wide variety of opportunities. "On the contrary," he added, "it is the purpose of the Russian system to discourage a shift of employment from one specialty field to another."

This results in dividing engineering education into some 150 different specialties, such as mechanical engineer-automobile designer or mechanical engineer-automobile maintenance. It "contrasts sharply with the less than twenty fields that are currently accredited in the United States," Professor Fadum remarked.

Admitting that the U.S. mission found Russian engineering education to be highly efficient and well geared to the system in which it operates, he added: "that is not to say, however, that the USSR system of producing highly specialized engineers should be emulated by us. The high degree of specialization and the standardization imposed by the authority of the Ministry of Higher Education would hardly seem appropriate for any serious consideration in this country."

The mission found that the Soviet educational system specifies the number who may enter the institutions of higher education, the number who may train for each field of specialization, the quota of each specific institute for each specialty, and the jobs that will be available at the time of graduation.

Professor Fadum reported that a plan now being formulated by the Russian state contemplates that an average of 350,000 graduates in all professional fields —engineering, science, medicine, language, etc.—will complete their training each year. This represents an increase of 40 percent over the average for the past five years, but in engineering the proposed increase is 90 percent.

Nowhere, he added, is the engineer and scientist held in higher regard than in the USSR. "Indeed, engineers and scientists are among the aristocrats of society," he declared. "Engineering students and practicing engineers are exempt from military service."

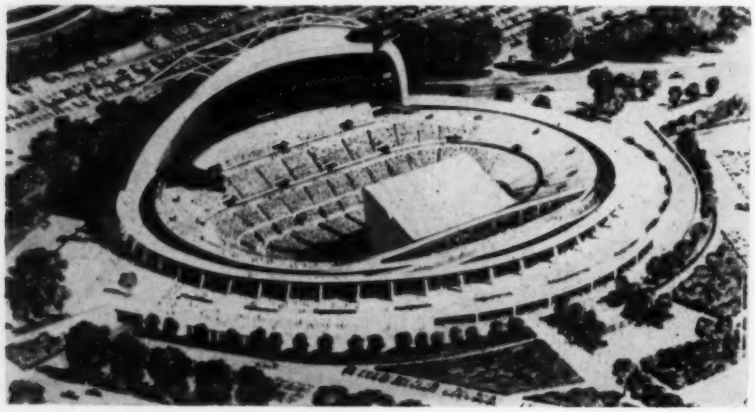
In addition, no student need want for a higher education because of lack of financial resources. From 85 to 90 percent of the students are given grants based on need and aptitude. There are even bonuses for honor students.

In the Russian system, an engineering education opens the door to positions of high rank. While the limit of achievement of the non-graduate in an industrial enterprise is the position of foreman, this is considered the starting position for an engineering graduate. Professors of engineering, he added, are paid on the same scale as chief engineers of major industrial enterprises. This is about 4,000 rubles per month, currently the equivalent of $400.

Despite the apparent advances made in engineering education, however, Professor Fadum reported that the Russian administrators are not too happy about it, mainly because the middle school graduates do not have an opportunity for higher education, which is "a cause of great concern." Educational institutions everywhere in Russia appear to be overcrowded, the educator said, adding that there is no doubt that opportunity for higher education is in no small part limited because of this fact.

Work Starts on Pittsburgh Civic Auditorium

Pittsburgh Civic Auditorium—a key structure in Pittsburgh's Golden Triangle redevelopment project—starts to shape up as the foundation, podium slab, and ring girder are cast, using Plastiment concrete. The $20,000,000 auditorium, shown here in artist's rendering, will seat up to 14,000 and occupy 20 acres with its mall and parking lot. The 415-ft-dia structure features a retractable roof, which is push-button operated. The unique cover consists of eight gigantic orange-peel-shaped pieces of stainless steel, fitted into a structural steel frame. Concreting began in July 1958, and completion of the auditorium is expected by late 1960. The architects are Mitchell & Ritchey of Pittsburgh. R. A. Zern, of Pittsburgh, is the consulting engineer for the substructure, and Ammann & Whitney, of New York, for the roof and superstructure. The Dick Corporation, of Large, Pa., is general contractor.



Plastics Plant to Be Built in Argentina

An Argentine company has received an Export-Import Bank credit of $8,000,000 as an aid toward construction of a plant to manufacture the basic materials of plastic products. The credit, authorized to Industrias Plasticas Argentinas Koppers, is the result of cooperative efforts of U.S. and Argentine industrialists, with the support of both governments, to develop a petrochemical industry in Argentina. The Export-Import Bank credit, which represents less than half the cost of the new plant, will finance purchases of essential industrial equipment in the United States as well as U.S. engineering services.

The proposed $17,000,000 ethylene and polyethylene plant will be the first to make use of gases from Argentine refineries that are being wasted now. The polyethylene to be produced will make possible the substitution of plastics for many purposes now utilizing metals. One of the prime markets will be plastic pipe for underground use and for irrigation and farm water supplies.

The plant will be built near Buenos

Aires and will be ready for operation in 1961. It will be built and owned by Industrias Plasticas Argentinas Koppers, a company in which Koppers International (a wholly owned subsidiary of Koppers Company, Inc.) has a substantial interest.

Cement Company to Build Hawaii Plant

Plans to build a cement-manufacturing plant in Hawaii are announced by the Permanente Cement Company. To be built in the Waianae area of the Island of Oahu (near Honolulu), the plant will utilize large native deposits of lime, the principal raw material for cement making. With an initial annual capacity of 6,800,000 sacks of cement a year, the installation will raise the company's investment in facilities in Hawaii and the other Pacific islands to $20,000,000.

Kaiser Engineers Division of the Henry J. Kaiser Company will design and supervise construction of the new plant, which will feature efficient, dust-free operation. The target for start of cement production is August 1960.

Nonfarm Housing Starts Increased in 1958

Reversing a two-year downtrend, nonfarm housing starts rose to a total of almost 1,200,000 units in 1958, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. The unusually large volume of housing, begun in the second half of the year, pushed the 1958 total 15 percent above 1957, to the highest level since 1955.

Private housing begun in 1958 totaled 1,130,600 units, or 14 percent more than in 1957. Gains over the year were due mainly to a sharp up-turn in FHA-assisted housing, which accounted for 26 percent of the privately financed starts in 1958, compared with 17 percent in 1957. Conventionally financed private housing declined from 70 percent in 1957 to 65 percent in 1958. Housing started under the VA program was down 20 percent from 1957, and represented only 9 percent of the 1958 private total.

Publicly owned housing placed under construction in 1958 totaled 67,100—the largest number started since 1951. Much of the increase in this category was to provide housing at military installations under the Capehart program.

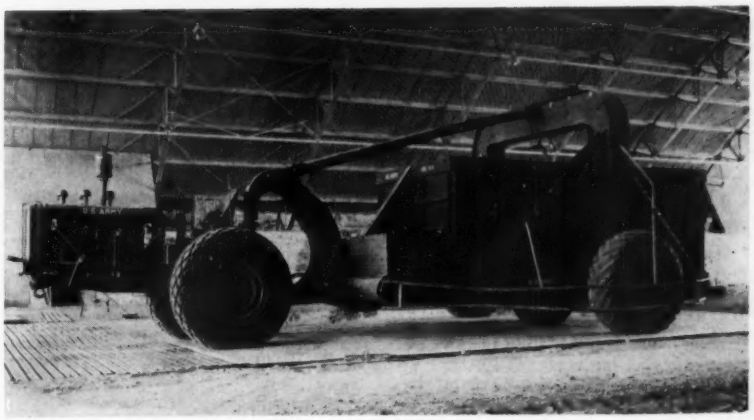
Last year's gains in new housing were greatest in the metropolitan areas of the country, reflecting the upturn in apartment construction as well as increased activity under the FHA programs. While all regions of the country shared in the improvement in homebuilding volume, the 1958 advance was stronger in the South and West than in the Northeast and North Central regions.

Concrete Placed in New Cumberland Dam

About 60 percent (35,000 cu yd) of the concrete for the first stage of the New Cumberland Dam at Stratton, Ohio, has been placed, despite delays caused by the flooding of the cofferdam during winter high water and ice runout. Shown here are three of the five piers inside the 160- by 500-ft cellular cofferdam, with a whirler crane lowering a batch bucket of concrete into position for placing. The first stage of the dam is scheduled for completion in late summer. The Dravo Corporation is the contractor.

Army Develops Plastic Airplane Landing Mat

Experimental plastic airplane landing mat for emergency use on heavy-bomber airfields has been designed at the Corps of Engineers' Waterways Experiment Station at Vicksburg, where it is being tested (see photo). Designated T12, the mat is a sandwich structure composed of glass fiber—phenolic resin honeycomb core material bonded between laminated facings of phenolic resin impregnated glass fabric. With a weight of only 150 lb, the panels are easily transported and handled. Panel connections are made by tongue-and-groove side and end connectors, built into the panels. Tests indicate that the mat can sustain emergency operations (two weeks) of aircraft having a single-wheel load of 50,000 lb and tire contact pressure of 200 psi. The design is currently being modified to develop a mat that will stand up under six months' emergency operation.



Unique Design for Oregon Centennial Building

Forest Products Pavilion—planned for Oregon's centennial exposition and trade fair this year—demonstrates new uses for wood in architecture. The 24,000-sq ft futuristic structure will consist of seven sweeping hyperbolic paraboloids, each 50 ft square, supported at only six points. It will be constructed of two layers of 1-in. tongue-and-groove lumber with 7½ x 9-in.-edge stiffening beams. The roof will be built up with tar and white pebbles. Skylights will be constructed between each of seven shells. Water, draining off the roof at six points, will flow into moats at the edges of the covered area. Wooden bridges will carry foot traffic over the moats into the building. Cost of erecting, furnishing, and maintaining the pavilion during the fair will be about $150,000. Architect for the pavilion is John Storrs, and the engineer James G. Pierson, both of Portland. The pavilion will be dedicated this summer.

AEC to Have New Reactor at Hanford

The Atomic Energy Commission is negotiating with Kaiser Engineers, of Oakland, Calif., for the principal construction work on a new production reactor at its Hanford Works, Richland, Wash. The project was authorized by the 85th Congress at an estimated cost of $145,000,000. The graphite-moderated reactor will be for the production of special nuclear materials, with design features permitting conversion to power production if desired at a later time. Sixteen firms were invited to submit proposals for a contract, and fourteen responded. The work, to be performed under a cost-type contract, will require about four years.

The reactor design engineering is being performed by General Electric. Burns and Roe, of New York City, are supplying architect-engineering services for the supporting facilities.

Basic Oxygen Furnaces For Jones & Laughlin

Construction will start this summer on the two largest basic oxygen furnaces in the world at the Cleveland Works of the Jones & Laughlin Steel Corporation. The company's $50,000,000 expansion program will also include one of the largest blast furnaces in the United States. The new basic oxygen furnaces are expected to produce 160-ton heats. The new blast furnace will be 110 ft high, with a diameter of 32 feet and a working volume of 65,000 cu ft. With a daily rated capacity of 2,500 tons, it will increase the yearly rated iron capacity of the plant from 866,000 to 1,800,000 tons.

Since 1942 when Jones & Laughlin purchased the Cleveland Works (formerly the Otis Steel Company), it has spent more than $165,000,000 in equipping the unit to be one of the top producers of hot and cold rolled sheets. Its output goes chiefly to the automotive and appliance industries.

Structural Steel Chosen For Stroudsburg Bridge

The Bethlehem Steel Company has been awarded a contract to fabricate and erect a new highway bridge over Brodhead Creek between the boroughs of Stroudsburg and East Stroudsburg, Pa. The structure will replace a temporary bridge that has connected the two towns since the flood of 1955 in which a two-lane, two-span truss bridge was carried away. It will be a four-lane continuous girder bridge, consisting of a 150-ft main span and two side spans of 120 ft each. About 630 tons of structural steel will be used.

The steel bridge was successfully bid against a prestressed concrete design, which was to have been continuously poured in place on falsework, erected in the stream. The prestressed bridge would have been a monolithic structure, with deck and girders poured at the same time and as one unit, utilizing post-tensioned tendons. The general contractor is J. Richard Nissley, Inc.

San Francisco Names Firms For Rapid Transit Study

Selection of a three-firm team of engineering consultants to prepare detailed plans for a regional rapid transit system to serve the five-county San Francisco Bay area is announced by the San Francisco Bay Area Rapid Transit District. The firms named are Parsons, Brinckerhoff, Hall and Macdonald, of New York City, and the Bechtel Corporation and the Tudor Engineering Company, both of San Francisco. The three firms have entered into a joint-venture agreement for the project under the name of Parsons-Brinckerhoff-Tudor-Bechtel.

Under the terms of a $600,000 contract being negotiated, the joint-venture group must complete detailed plans for a rapid-transit rail system by May 1960—six months before the plan is to be submitted to the voters in support of a general obligation bond issue. The system will serve Alameda, Contra Costa, Marin, San Francisco, and San Mateo Counties.

Solvang-Santa Ynez Project Approved

The Department of the Interior has approved application for a $3,800,000 loan to the Santa Ynez River Water Conservation District, Santa Barbara County. Proceeds from the loan will be used to construct a water main from Cachuma Dam in Santa Barbara County to the Santa Ynez-Ballard-Solvang area. The main will be about 170,000 ft long, in diameters from 6 to 30 in. The repayment period of the loan is forty years.

In the planning stage for almost six years, the project is now practically assured. The application has been transmitted to Congress where it must remain in committee for sixty days before funds can be appropriated. The application and report were prepared for the Conservation District by Dean S. Kingman, M. ASCE, consulting engineer of Palo Alto, Calif.

Laying the Second San Diego Aqueduct

In its 100-mile course from the Metropolitan Water District of Southern California's Colorado River Aqueduct to San Diego's Lower Otay Reservoir, the Second San Diego Aqueduct passes over slopes (up to 56 percent) that test the ingenuity of the contractor. Here one of the contractors, Vido Artukovich & Son, uses a heavy timber wedge to level the crane in laying 75-in. concrete cylinder pipe on a 47-deg. slope, where rock formation close to the surface made benching impractical. A train of three D-8 Cats was used to help the crawler crane move up the slope. The Metropolitan Water District designed the Second Aqueduct and is supervising its construction as far as the San Diego County line where the San Diego County Water Authority takes over. Pipe was supplied by the United Concrete Pipe Corporation.

Neare's N. G. COLUMN

R. ROBINSON ROWE, M. ASCE

"I promised," began Professor Neare, "to say a few words about the United Engineering Center. It will be 18 stories high, as wide as it is high, and as handsome as it is high. It will be worth $20,000,000, but will cost only $10,000,000. We have over $9,000,000 in cash and pledges and are working on the last million. Every dollar will be thankfully received, but the share of each member is $18.75. That share goes down $0.01 for every 23 new members, so let's all hustle for more money or more members. Any questions?"

"Haven't we made our quota?" asked Joe Kerr. "You said last April that Titus Wadham and his staff tried to give you the run-around by each offering to give some fraction of what all the others gave, and that a new Junior named Dan crossed them up by giving $1.10. I figure that Dan primed the pump and you collected your last $1,000."

"Show me, Joe."

"Well, you probably went back to Titus for a third of $1.10 and he gave you 37¢. Then you had $1.47 and asked Irvin for ¼ of it and got another 37¢. Next to George for a fifth of $1.84, and he put in 37¢. The sixth from Henry and the seventh from young Titus figured the same, but the fifteenth from Wilbur and the eighteenth from Art were only 20¢ and 17¢. This is summarized in two columns of this table

T	0	.37	.61	.66	.67
I	0	.37	.52	.53	.53
G	0	.37	.45	.44	.44
H	0	.37	.38	.38	.38
T Jr	0	.37	.33	.33	.33
W	0	.20	.16	.17	.16
A	0	.17	.14	.14	.14
D	1.10	.00	.00	.00	.00
Sub	1.10	2.22	2.59	2.65	2.65
Total	1.10	3.32	5.91	8.56	11.21

Then you could go back to Titus again and say you had $3.32, of which $2.95 came from the others, that Titus' third was 98¢, and collect 61¢ more. You would collect $2.59 the third round and $2.65 the fourth round. The fifth round would still be $2.65 and so would all other rounds. On the 379th round you'd make your quota, say thanks and go home. Titus would fire Dan and start figuring how much he could salvage on his income tax."

"Joe was misled by the breakage of fractions of a cent," argued Cal Klater. "Titus's offer to contribute a third of what the others gave was equivalent to giving ¼ of the total given, from which I wrote:

$$x = \frac{x}{4} + \frac{x}{5} + \frac{x}{6} + \frac{x}{7} + \frac{x}{8} + \frac{x}{16} + \frac{x}{19} + 1.10$$

$$\frac{11x}{31920} = 1.10$$

$$x = \$3192$$

I think you would collect it all, especially the $798 from Titus to teach him a lesson."

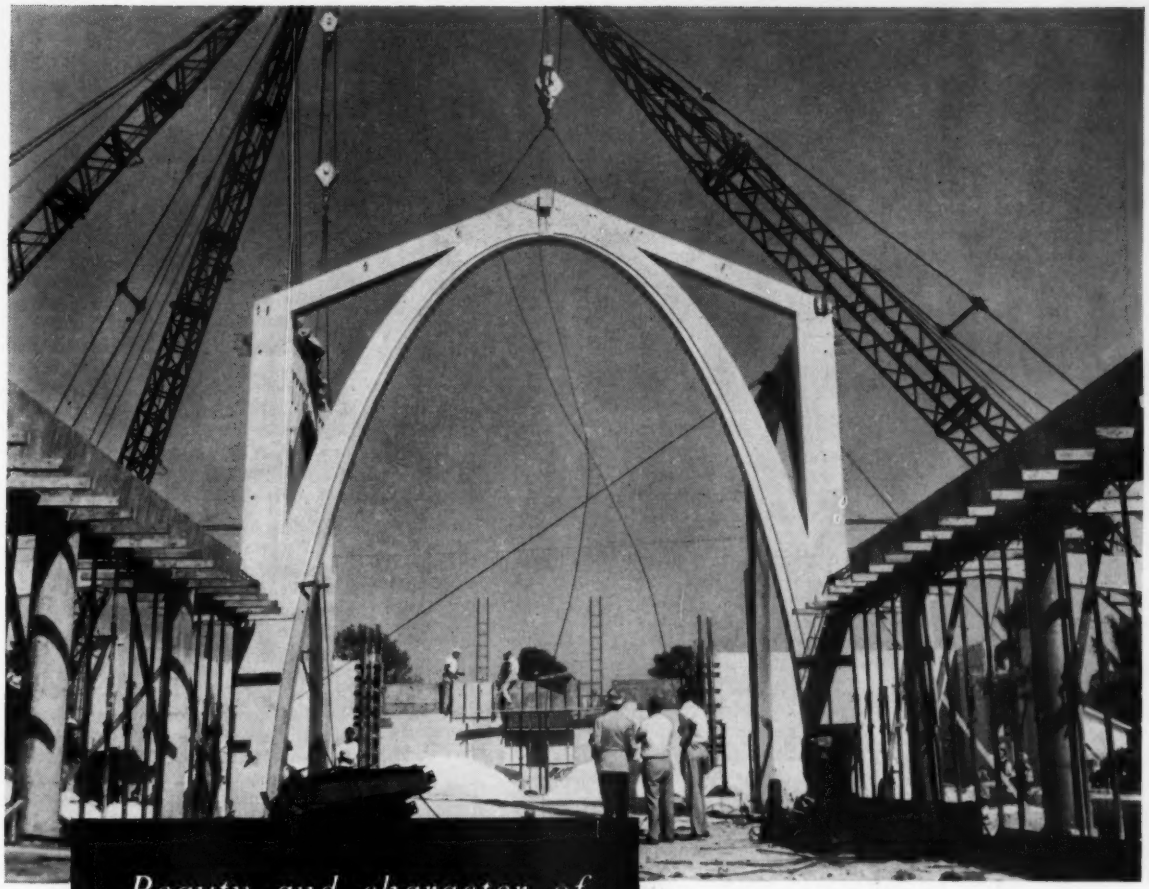
"I did, but not to teach him a lesson. Titus is instinctively tight but he never regrets giving. The very next day he dropped in at the Engineers Club to brag that he had given nearly $800. He dropped in to see the plans at the architects' office yesterday—said he had given nearly $1,000 and wanted the building perfect in every detail. He'll be one of the proudest when the building is finished, and proudest of his part in it.

"Instead of a new problem, I have a request. Considering the purpose of registration examinations, tell me which P.E. exam problem you think was best, and why."

[*Cal Klaters were Robert S. Johnson, James P. Bruner, Duane E. Edge, Thatchrite (Guy C. Thatcher), Ed C. Holt Jr., S. K. Rueball (Keith Jones), Ad L. Pate (G. H. Wilsey), Dana E. Low, R. E. Philleo, E. Nigma (Mrs. Robt. E. Craig II), O'Kay (Otto H. S. Koch), G. Nyusa (Robert M. Dodds), Thomas M. Morgan, Sauer Doe (Marvin A. Larson), Donald E. Milks, Al Gorithm (Lawrence E. Goodman), Marion C. Davidson, Frank S. Bole, German Gurfinkel, Allen Holmes, and N. U. Thead (Neville Donovan)*]

Steel Companies Spent $1.2 Billion in 1958

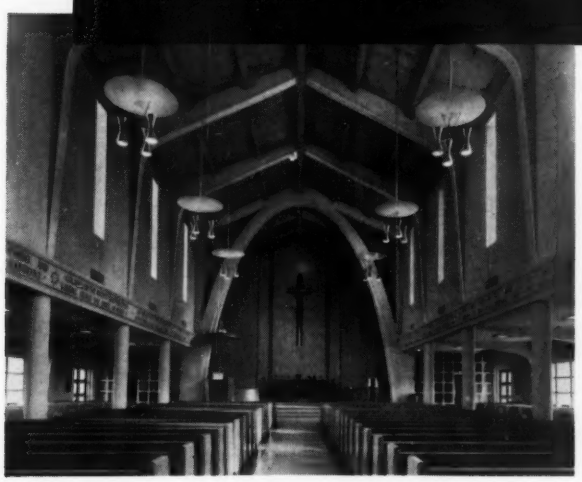
To meet the ever-increasing need for more and better steel, iron and steel companies in the United States laid out $1.2 billion for new equipment and construction last year, according to the American Iron and Steel Institute. This raised the postwar total for such outlays to more than $11 billion for the 1946-1958 period. In six of the past eight years expenditures have equaled or exceeded $1 billion a year. In 1959 the industry is planning to spend at least $1 billion more for plant expansion and improvement.



Beauty and character of new church owe much to

PRECAST CONCRETE

This church exemplifies the adaptability and beauty of modern precast concrete construction. Precast units serve both structurally and decoratively, and include 28 arches of varying sizes, 2 spire grills, 4 ornamental grills, and 42 precast window frames and sills. The largest arch is 32′ high.



Soaring arches, ornamental grills, window frames and sills—all precast concrete—lend enduring beauty and character to the new St. Peters Lutheran Church, Miami, Fla.

In precasting this wide variety of concrete units, Lewis Manufacturing Company used Lehigh Early Strength Cement for maximum production efficiency and economy.

"Our entire operation," writes Mr. Lewis, "has always been geared to the use of Lehigh Early Strength Cement and live steam curing. This fast production method enables us to give our customers better service, at lower cost."

This is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction.

Architects-Engineers: T. Norman Mansell, Philadelphia, Pa.
Scott B. Arnold Assoc., Miami, Fla.
Contractor: Thompson-Polizzi Construction Co., Coral Gables, Fla.
Precast Units Supplied by: Lewis Manufacturing Co., Miami, Fla.

Lehigh Portland Cement Company
ALLENTOWN, PA.

LEHIGH EARLY STRENGTH CEMENT • LEHIGH PORTLAND CEMENT • LEHIGH AIR-ENTRAINING CEMENT • LEHIGH MORTAR CEMENT

DECEASED

John B. Barnhart (J.M. '55), age 26, Ensign, U. S. Navy, was lost at sea recently, while participating in operations off the carrier Bennington near the Philippines. A 1955 civil engineering graduate of Purdue University, Ensign Barnhart worked as an instrumentman on the New York Central Railroad in Mattoon, Ill., before reporting to Newport, R. I., January 1956 as an officer candidate.

John A. Baumgartner (A.M. '31), age 56, died in Tehran, Iran, on February 22. He had been in Tehran since June 1956 as an engineering specialist with the U.S. State Department to assist the Iranian government in the development of water resources. For thirty-one years (1925 to 1956) Mr. Baumgartner was with the U.S. Geological Survey, Water Resources Division, with headquarters at Tucson, Ariz., engaged in determining the flow and water resources of the Colorado and Gila Rivers. He was a civil engineering graduate of Oregon State College.

Harry A. Briggs (M. '15), age 88, retired engineer of Mansfield, Mass., died there recently. A specialist in dam construction, Mr. Briggs had served as assistant engineer on the Wachusett Dam for Boston, as construction engineer on the dams and dikes for the Ashokan Reservoir, and as construction engineer on Scituate Dam and purification works for Providence, R. I. He had been in retirement since 1933.

Albert Wells Buel (M. '11), age 97, former chief bridge designer for the New York State Highway Commission, died in Jersey City, N. J., on April 20. Mr. Buel retired in 1935 after more than forty years experience specializing in reinforced concrete, particularly solid arch bridges. He had contributed a number of technical and professional articles to enginering periodicals, and in 1904 the first comprehensive treatise in English on "Reinforced Concrete," appeared under his name. Prior to joining the New York State Highway Commission, he worked as designer, engineer, and inspector on the New York City & Harlem Railroad, the Michigan Central Railroad, and the Guatemala Railroad, to name a few.

Gorden B. Canaga (A.M. '12), age 76, of Chevy Chase, Md., died there on February 27. A B.A. graduate of Mt. Union College, Ohio, in 1902 and a B.S.C.E. graduate of Cornell University in 1907, Mr. Canaga's first engineering work was with the Government of the Philippine Islands, where he served from 1907 to 1917, first as assistant engineer and then as designing engineer. During this time he designed eight large floating dry docks and a concrete bridge. After his return to the U.S., he was design engineer with the Philadelphia Department of Transit for several years. More recently he was structural engineer with Verus T. Ritter and Associates, of Philadelphia on the Delaware River Vehicular Tunnel.

Samuel Northrup Castle (M. '18), age 79, of Honolulu, Hawaii, died there on February 10. Mr. Castle was a retired industrialist, consulting engineer, business executive, and inventor. His engineering achievements and inventions—a centrifugal oiling device for Corliss engines and a type of fog-piercing searchlight for use on ships—won him many honors. Mr. Castle was born in Honolulu and educated at Oahu College (Punahou), at Halls an der Salle, Germany, and at Hamilton College. He received a bachelor's degree in engineering from Harvard University in 1901 and did graduate work at Cornell University from 1902 to 1904.

Wilbur W. Davis (M. '17), age 82, retired chief engineer of the Metropolitan Transit Authority, Boston, Mass., died there recently. A graduate of the Massachusetts Institute of Technology in 1900, Mr. Davis served on the Massachusetts Metropolitan Park Commission early in his career. On the staff of the Transit Authority from 1902 until his retirement in 1947, Mr. Davis had a hand in the design and construction of every rapid transit subway in Boston since the original Tremont Street Line was built in 1897.

Albert D. Elia (M. '53), age 53, architect-engineer of Niagara Falls, N. Y., died there recently. Since entering private practice in 1945, Mr. Elia had designed several department stores, schools, office buildings and the Medical Arts Building in Niagara Falls. From 1935 until 1942, when he joined the U.S. Army Corps of Engineers for overseas service, Mr. Elia had charge of design and supervision for the G. Harold Klein Company of Niagara Falls. He attended Chicago Teachers College, Buffalo University, and the University of Wisconsin.

Frank Morton Evans (A.M. '23), age 70, borough engineer for Bergen County, New Jersey, for forty-three years, died recently while vacationing in Rockledge, Fla. Mr. Evans was briefly (1918-1919 and 1921-1924) design engineer and chief engineer for C. H. & R. C. Peckworth Inc., of New York City.

Lamar D. Eyster (A.M. '38), age 61, general manager of the Eyster Engineering and Construction Company of Scottsboro, Ala., died recently. Mr. Eyster, in addition to maintaining the Eyster Engineering and Construction Company, for the past ten years had held a position with the Brown Engineering Company, of Huntsville, Ala.

Walter H. Fasshauer (A.M. '36), age 66, since 1941 chief engineer with the Kuljian Corporation, of Philadelphia, Pa., died there on February 14. Before joining the Kuljian Corporation, Mr. Fasshauer was associated for twenty-eight years with Bear Engineering Company, the last few years as president. He graduated from Drexel University in 1911.

Eugene Grove Haines (M. '10), age 84, retired assistant division engineer of the New York City Board of Transportation, died recently in Catskill, N. Y. Except for a short period in 1909 when he was transferred to the Board of Water Supply to work on the Catskill Aqueduct at New Paltz, Mr. Haines was engaged on subway and tunnel construction in Manhattan, Brooklyn and Queens from 1904 until his retirement in 1933. He came out of retirement briefly in 1934 to assist Arthur S. Tuttle, then New York State Director for the Federal Emergency Administration of Public Works, in the administration of that office.

Frederick Charles Hingsburg (M. '29), age 70, retired Captain, U.S. Coast Guard, and a resident of Orleans, Mass., died there recently. Prior to receiving his commission as a Captain in the Coast Guard in 1939, he served for nearly thirty years in the U.S. Department of Commerce—twenty of them as superintendent of the U.S. Lighthouse Service, of the Department of Commerce. As chief engineer of the Airways Division he was active in establishing 19,000 miles of airways and appurtenant facilities. Captain Hingsburg did his undergraduate work at Cooper Union and postgraduate work at the Polytechnic Institute of Brooklyn.

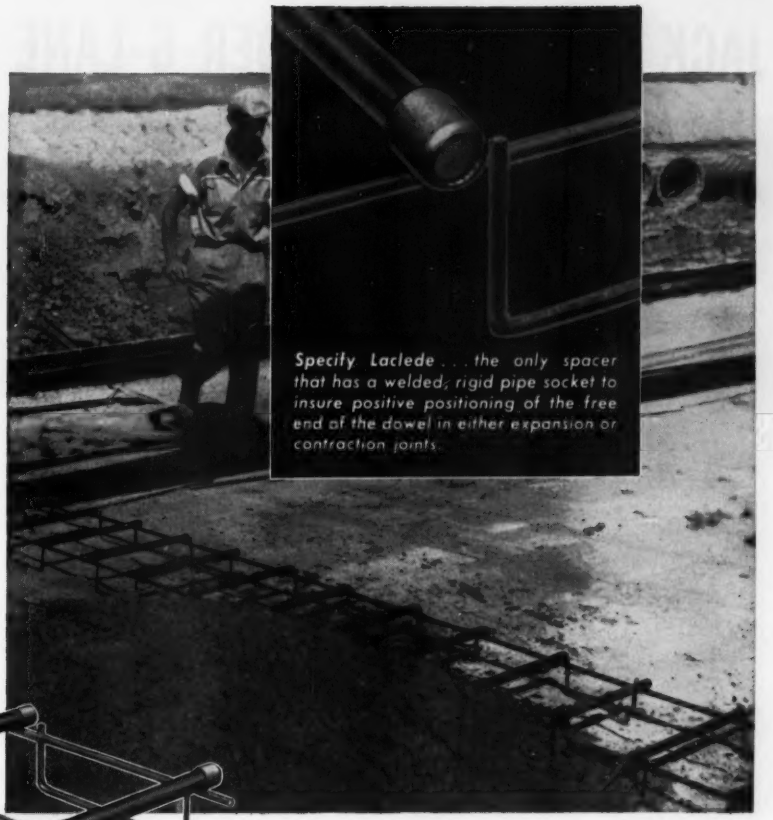
Bernard D. Johnson (M. '41), age 67, retired civil engineer of St. Albans, W. Va., died there recently. The major part of Mr. Johnson's professional life was spent with the West Virginia State Road Commission in Elkins, first, as district engineer in charge of highway construction and maintenance, and more recently, as construction engineer in charge of all highway and bridge construction for approximately one-third of the state. Mr. Johnson graduated from Ohio University in 1914.

H. Banks Kinnison (M. '37), age 69, retired Chief for the Western States of the U.S. Geological Survey's Surface Water Branch, with offices in Menlo Park, Calif., died there recently. At the time of his retirement last year, Mr. Kinnison had been an engineer with the U.S. Geological Survey for more than forty years. He was author of many technical articles, and a civil engineering graduate of the University of Idaho.

Clarence J. Nobmann (M. '55), age 62, retired civil engineer of Scarsdale, N. Y., died there recently. Mr. Nobmann graduated from the University of California with a B.S. in civil engineering. His first important job was with the Shell Company of California as structural engineer, designing reinforced concrete and steel structures for oil refineries. He re-

(Continued on page 120)

LACLEDE pre-assembled DOWEL UNITS



speed paving jobs

Expansion sleeves, chairs and spacer bars are all precision shop welded . . . by Laclede . . . into a complete dowel assembly for expansion, contraction and construction joints.

Delivered to the job site in a single, easy-to-handle unit that maintains rigid alignment, Laclede's new dowel assemblies speed paving jobs by cutting installation labor costs. Additional time and money can be saved by specifying Laclede dowel assemblies with dowels shop coated—ready for immediate installation.

LACLEDE HIGHWAY STEELS

- *prefabricated dowel units*
- *multi-rib round reinforcing bars*
- *center joints*
- *tie bars*
- *7-wire strand for prestressing*
- *welded wire fabric*
- *recess joints*
- *accessories*

LACLEDE

LACLEDE STEEL COMPANY

SAINT LOUIS, MISSOURI ◆ Producers of Steel for Industry and Construction

Deceased

(Continued from page 118)

mained with the company until his retirement a few years ago, becoming assistant manager of the Tax and Insurance Department in 1933; assistant manager of the Marketing Engineering Department in 1936; manager of the Safety Department in 1937; Division Operations Manager in 1940; priorities representative in Washington, D. C., in 1943; and manager of the Marketing Engineering Department in 1945.

Harry L. Noyes (M. '16), age 91, retired chief engineer of the Union Carbide Company, died recently in Niagara Falls, N. Y. A specialist in hydroelectric, industrial, and public utility facilities, he was with Union Carbide from 1898 to his retirement. He was chief engineer from 1915 to 1939, and then served the company for some years as consultant. He had also been consultant to the Electro Metallurgical Company. Mr. Noyes was a graduate of Massachusetts Institute of Technology.

George Mason Parker (M. '39), age 63, former chief of the Rivers and Harbors Branch of the Corps of Engineers, died in Norfolk, Va., recently. Mr. Parker was a graduate of North Carolina State College. With the Corps of Engineers for forty years, Mr. Parker had been in the Norfolk District from 1921 until his recent retirement—most recently as chief of the Rivers and Harbors Branch. Since 1950 he had received five commendations for his services, which included freeing the Battleship Missouri from Thimble Shoal and planning and executing the dredging of the York River entrance channel.

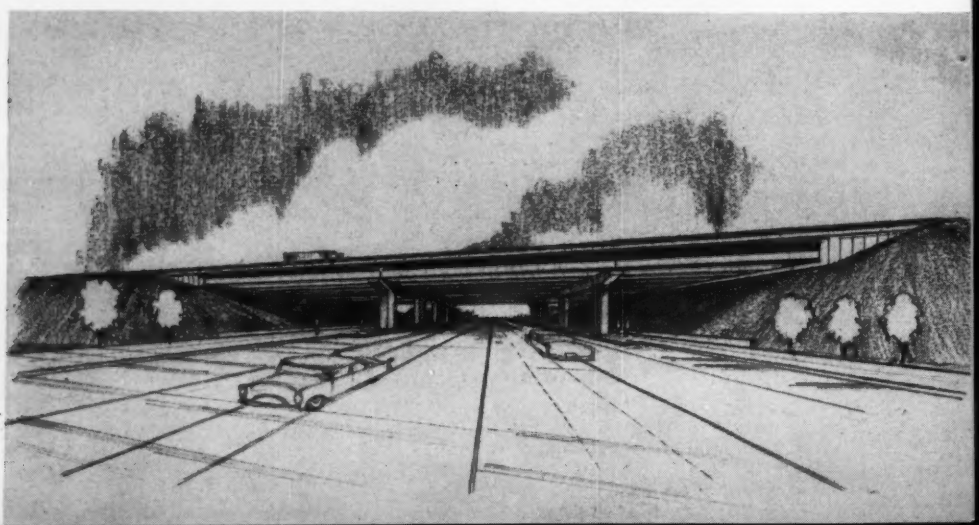
William Frederick Peters (A.M. '17), age 72, since 1934 president of the United Products Company of Akron, Ohio, died on February 20 while vacationing in St. Petersburg, Fla. A former service director of Akron under two administrations, Mr. Peters built the city's S. Main Street viaduct and E. Market Street bridge, eliminating a dangerous bottleneck over the railroad tracks at the old depot. Prior to going to Akron in 1916, he was engaged in railroad work and as an assistant city engineer for Elyria and an engineer for Medina County. He was a graduate of the University of Wisconsin.

Henri Rush (M. '18) age 84, veteran architect and former chief engineer for St. Louis, Mo., died recently in Harburg, Germany, the place of his birth. In 1904 he had designed the Airdrome and Boer Buildings for the World's Fair in St. Louis, and spent the next sixteen years as chief engineer in the Building Commissioner's office. Mr. Rush had lived at Harburg since retiring in 1953. That year the architectural firm of Rush, Lee, and Rush, which he had founded forty-eight years earlier, closed its doors.

(Continued on page 124)

Mr. C. H. Darby, Mr. O. J. Porter and Mr. W. F. Leivonen, Jr. discuss a problem involving the Burr Oak Avenue bridge on the Illinois Toll Highway.

Typical composite welded girder twin bridges carrying 8 lanes of Interstate Highway traffic over wide street in Salt Lake City.



Bronson Road overpass on Connecticut Turnpike. Steel can be welded, flame-cut, riveted, bolted. It's versatile and available.

Winning a coveted War Department award. Presented to Mr. O. J. Porter for discovery of a new method of compaction and stabilization of subgrades enabling airfield runways to be built to support very heavy airplanes.

50 steel bridges now being designed for Salt Lake City Interstate Highway

by Porter, Urquhart, McCreary & O'Brien, Consulting Engineers.

Steel bridges for some of the important highways in the country have been designed by the firm of Porter, Urquhart, McCreary & O'Brien. These include bridges on the New Jersey, Ohio, Connecticut, New Jersey Garden State and Illinois Toll Roads. Their big job at present covers seven miles of the Utah Interstate Highway which cuts through Salt Lake City and includes 50 steel bridges of composite welded girder construction. The highway will provide six and eight lanes of traffic, but allows space for eight and twelve lanes, eventually.

Steel goes up in hours!

According to Mr. O. J. Porter, Managing Partner, a large proportion of the firm's present work is in highway construction, including viaducts and overpasses. Both minimum cost and speed in opening the way to traffic are important considerations. Due to the ease of transporting fabricated short steel spans to urban bridge sites, erection is accomplished in a matter of hours, minimizing detours and tie-ups in traffic. Traffic hazards are substantially reduced by eliminating falsework. Furthermore, headroom may be increased in tight places through steel's high tensional strength qualities.

Steel adds beauty. By using steel, designs may be executed which actually add to the beauty and dignity of an urban neighborhood. This is an important consideration which should always be kept in mind.

Steel reduces costs. Frequently, the lighter construction possible with steel, reduced foundation costs and faster erection saves labor. New, tougher, high-strength and alloy steels provide greater strength with less bulk.

Increased facilities. There is an ever-expanding demand for steel because of its many advantages in the fast-growing market for bridge construction. The steel industry has had the foresight to grow with this vigorous market through greatly expanded facilities for manufacture of structural shapes and plates. You can confidently design in steel—the material you know best, the material that offers most—knowing it will be available.

USS is a registered trademark

Deceased

(Continued from page 120)

Edgar P. Snow (M. '53), age 54, president of the C. W. Riva Company, of Providence, R. I., died there on April 16. As president of the company, he had charge of the design of water systems, sewage systems and treatment works, highway and bridge design, as well as the negotiation of contracts. Before joining the C. W. Riva Company in 1951 as chief engineer, Mr. Snow worked on the Queens and Midtown tunnels for the Walsh Construction Company of New York, and with the Gilbane Building Company in various capacities, including superintendent and chief engineer. He was a 1927 graduate of New York University.

Jaromir Jan Soucek (M. '48), age 58, professor of highway engineering at the Benes Technical University in Brno, Czechoslovakia, died there on February 1. A professor of long standing, he organized the Road Construction Institute, and served as its chief in 1951. At the same time he was president of the Road Section of the Scientific Technical Society for Transport in Brno. Professor Soucek had designed steel and reinforced concrete buildings for Granger & Bollen bacher, and waterworks, sewage disposal plants and hydraulic structures for Alvord, Burdick & Howson, both Chicago firms.

Kenyon C. Vail (M. '58), age 59, consulting engineer for the Tulsa Testing Laboratory, Denver, Colo., died there recently. Early in his career, Mr. Vail served for ten years with the Colorado Highway Department as materials engineer in charge of highway laboratory sampling and testing. Subsequently he was soil engineer for Crocker and Ryan, Denver consulting engineers; manager and owner of Laboratory Engineers, a private laboratory testing construction materials; materials engineer and highway construction engineer for the U.S. Bureau of Public Roads at Ankara, Turkey; and Denver city inspector.

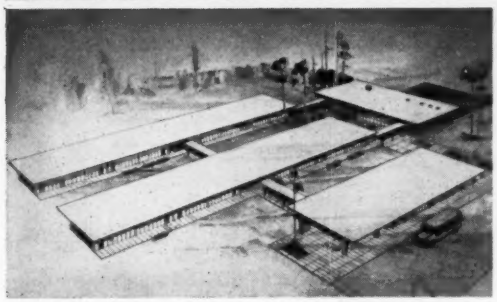
Elliott B. Van Hook (M. '37), age 60, retired civil engineer of Bryn Mawr, Pa., died there recently. Mr. Van Hook was employed by United Engineers & Constructors, of Philadelphia, at the time of his retirement last year. Previously he was chief engineer for the Philadelphia firm, J. H. Vickers Company. Mr. Van Hook was a graduate of Pennsylvania State University.

Karl Eugene Vogel (M. '24), age 76, retired vice president and general manager of the Omaha Steel Works, Omaha, Nebr., died there on February 9. Mr. Vogel's first job after graduating from the University of Michigan with a B.S. in civil engineering, was with the American Bridge Company. In 1947 he retired from the Omaha Steel Works, rounding out thirty-six years of employment. Since his retirement he had served as senator in the Nebraska Legislature.

Russell Calvert Wagner (J.M. '57), age 23, a PFC in the 52nd Infantry in Germany died on February 3, from injuries sustained in an accident. Mr. Wagner received his B.S. in civil engineering from the Illinois Institute of Technology in 1957.

Lloyd K. White (M. '52), age 65, retired city engineer of Wichita, Kans., died there recently. Mr. White became city engineer in 1944, with responsibility for surveys, design plans, estimates, specifications, and letting of contracts for all municipal construction. Earlier in his career he had served as inspector, field engineer, resident engineer, and Sedgwick County assistant engineer in the Kansas Highway Department.

Chester G. Wigley (M. '20), age 75, of Boulder City, Nev., died there recently. A specialist in sanitation, sewerage, and water supply he joined the New Jersey State Department of Health in 1910, as an assistant engineer, advancing to chief engineer in 1913. In 1920 he acted as a special assistant to the Department on the design and construction of sewer and waterworks and as an expert in valuation. For the next several years he maintained a general consulting practice.



Normandy Elementary School, Jacksonville, Florida. *Architects:* George Ryad Fisher, A.I.A. and Harry E. Burns, Jr., A.I.A. *Contractors for 4 schools:* 1) McMaines Construction Co., Jacksonville. 2) East Coast Construction Co., Jacksonville. 3) Bay Construction Co., Norfolk, Va. 4) Wm. S. Smith Construction Co., Jacksonville. *Prestressed Concrete Fabricator:* Capitol Concrete Co., Prestress Div., Jacksonville.

New Prestressed Concrete Florida Elementary School Wins Design Award

Low completed cost prompts School Board to build 3 additional schools of same design

The greatest single requirement for the Duval County elementary school was economy of construction. In close order came fireproofness and ease and economy of maintenance.

The structure is approximately 35,360 sq ft in area and contains some 39,000 sq ft of prestressed Double T roof slabs. Over-all, the school represents about 300,000 cu ft at the contract price of $297,000; the cost per sq ft being $8.40. That's the cost benefit... there are others.

At the Sarasota regional conference of the American Institute of Architects in 1958, only one school was recognized for an award among various types of buildings from four states. This was the school.

Further, the $8.40 cost per sq ft, together with the fireproof and maintenance-free character of the building, *so pleased the School Board that it has seen fit to build it, with slight modifications, on three additional sites.*

You see how the success of prestressed concrete repeats itself? This local acceptance of prestressed concrete is being duplicated throughout the nation. Not only in schools, but in office buildings, garages, warehouses, motels, bridges, piers, factories and transportation terminals.

Because Roebling pioneered in the development of prestressing elements and techniques in the United States, we have much to tell you and a wealth of information and data to share with you. Your inquiry can be as general as "... all about prestressed concrete," or as specific as "... tensioning elements and casting bed data." In any case, we will be glad to furnish you with whatever you wish. Just address *any* inquiry to Construction Materials Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

Consult Roebling... *First* in the U. S. with prestressing and tensioning elements

ROEBLING

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Subsidiary of The Colorado Fuel and Iron Corporation

Non-ASCE Meetings

Air Pollution Control Association. Annual meeting at the Hotel Statler in Los Angeles, Calif., June 22-26. For details write Harry M. Pier, Executive Secretary, Air Pollution Control Association, 4400 Fifth Avenue, Pittsburgh 13, Pa.

American Association of Cost Engineers. Third annual meeting at Carnegie Institute of Technology in Pittsburgh, Pa., June 22-26. Additional information from J. F. Lovett, Convention Publicity Chairman, Pittsburgh Coke and Chemical Company, 1970 Grant Building, Pittsburgh 19, Pa.

American Institute of Electrical Engineers. Summer and Pacific General Meeting in conjunction with the Air Transport Conference at the Olympia Hotel in Seattle, Wash., June 21-26. For further information write to Raymond C. Mayer & Associates, 51 East 42nd Street, New York 17, N. Y.

American Society for Engineering Education. 1959 annual meeting in Pittsburgh, Pa., June 15-19. The University of Pittsburgh and Carnegie Institute of Technology are co-hosts. For information write W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

American Society for Testing Materials. Sixty-second annual meeting at Haddon Hall, Atlantic City, N. J., during the week of June 22. Inquiries should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

American Water Works Association. Annual Conference in San Francisco, Calif., July 12-17. Address queries to: American Water Works Association, 521 Fifth Avenue, New York 17, N. Y.

Pennsylvania State University. A summer seminar on "Plastics—Its Mechanical Properties, Design and Applications" on the Penn State campus, University Park, June 29-July 3. Requests for further information should be directed to L. W. Hu, Department of Engineering Mechanics, Engineering A Building, University Park, Pa.

United Nations Educational, Scientific and Cultural Organization. Conference on Electronic Computers and New Science of "Information Processing" in Paris, June 15-20. Information available from United Nations, Office of Public Information, United Nations, N. Y.

University of California. First International Conference on waste disposal in the marine environment sponsored by the University's Sanitary Engineering Research Laboratory and Institute of Marine Resources and the California State Water Pollution Control Board on the Berkeley campus, Dwinelle Hall, July 22-25. Application and program information available by writing to the Department of Conferences, University Extension, University of California, Berkeley 4, Calif.

Installing a trunk main in Queens. The Mayor of New York, Hon. Robert F. Wagner; Armond D'Angelo, Commissioner of the Department of Water Supply, Gas and Electricity; Edward J. Clark, Chief Engineer.

REPORT FROM NEW YORK CITY

685,000 ft of steel pipe—and never a break!

New York's experience with large-diameter steel mains dates back to 1910—nearly 50 years. In fact, since the mid-twenties, the City has specified steel pipe for mains 30 in. ID and over. The City now has in operation some 685,000 ft—nearly 130 miles—of steel pipe.

The chief reason for using steel has been to avoid the tremendous damage that can be caused by the breaking of mains made of brittle materials, resulting in the flooding of subways, basements, etc. New York's policy has paid off. All steel mains have been in virtually continuous operation since their installation, with never a major failure.

Large-diameter steel pipe, coated and lined with coal-tar enamel, is unexcelled for water transmission and distribution mains. No other material can equal its resistance to damage due to external loadings. It withstands impact and vibration; it has the beam strength to span washouts. And modern, protective materials maintain its continued high flow capacity indefinitely.

Most of the nation's major cities regularly specify tar-enameled steel pipe. It's pipe you can rely on. We'd be glad to tell you more about it. Please contact the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

RECENT BOOKS

(added to the Engineering Societies Library)

American Power Conference Proceedings

Volume xx

Papers dealing with varied aspects of the generation, transmission, and utilization of power. Among the topics discussed are steam and gas turbines; water technology; hydroelectric power; nuclear power development; industrial plants; central stations; transformers; extra-high voltage systems; distribution equipment; fuels; heating, ventilation and air conditioning; computers and network analyzers. (Published by Illinois Institute of Technology, Technology Center, Chicago 16, Ill., 1958. 748 pp., bound. $8.00.)

ASTM Standards on Cement

The present collection of standards contains revisions in 15 of the 34 standards included, among which are those dealing with Portland blast-furnace slag cement and sampling hydraulic cement. In addition a manual on cement testing is included, with detailed information to assist the plant chemist in the performance of cement tests. (Sponsored by ASTM Committee C-1. American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1958, 270 pp., paper. $3.50.)

ASTM Standards on Plastics

Forty-three new standards are included in this revised edition. Important new standards include nonrigid vinyl chloride plastic sheeting, glass fabric reinforced epoxy resin laminates, and polymethylstyrene molding and extrusion material. Also included is a new group of standards on plastic pipe and a tentative list of abbreviations of terms relating to plastics. (Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1958. 1108 pp., paper. $8.00.)

Australian Road Practice

Although intended for the use of Australian engineers engaged in highway engineering, this volume will be useful in any situation where the problem of creating and maintaining adequate roads over vast distances at comparatively low cost is encountered. Beginning with a thorough examination of the nature of soil and drainage, the author then discusses pavement design, materials, construction plant and methods, and the organization of construction. Methods and organization of road maintenance are treated fully, and the principles of road design are presented. The problems of administration and finance conclude the book. (By H. M. Sherrard. Cambridge University Press, 32 East 57th Street, New York 22, N. Y., 1958. 407 pp., bound. $19.50.

Book of ASTM Standards, 1958

The triennial compilation of ASTM Standards, expanded in this edition from seven to ten parts occupying 13,600 pages. A total of 2,450 standard specifications, methods of test, definitions of terms, and recommended practices are included in the various sections which deal with ferrous metals specifications; non-ferrous metals specifications; methods of test for metals; cement, concrete, mortars, road materials, waterproofing, soils; masonry products, ceramics, thermal insulation, sandwich and building constructions, acoustical materials, fire tests; wood, paper, adhesive, shipping containers, cellulose, leather; petroleum products, lubricants, tank measurements, engine tests; paint, naval stores, aromatic hydrocarbons, coal, coke, gaseous fuels, engine antifreezes; plastics, electrical insulation, rubber, carbon black; textiles, soap, water, atmospheric analysis, wax polishes. The volumes are available separately. (Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1959. 10 vols., bound. $116.00.)

Engineering Vibrations, With Applications To Structures And Machinery

Introduction to the analysis of technical vibrations of linear and nonlinear systems with particular emphasis on the transient state of motion. Classical analytical methods are used where feasible as are approximate methods, including the phase-plane graphical method for the solution of transient problems and the Ritz averaging method for solving steady state nonlinear problems. Attention is given to the physical aspects of vibration problems, and nonlinear relationships are introduced where possible. (By Lydik S. Jacobsen and Robert S. Ayre. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1958. 564 pp., bound. $10.00.)

Joints and Cracks In Concrete

Essentially this is a practical guide to the use of joints in the building of sound structures, although some consideration is given to theoretical aspects. It gives a survey of jointing materials and methods of construction, describes correct and economical jointing techniques, and discusses diagnosis and treatment of faults. With the aid of diagrams and photographs most types of concrete structures in which jointing problems are likely to arise are covered, including buildings, water-retaining structures, pavings, bridges, masonry construction, and concrete pipes. (By Peter L. Critchell. Contractors Record, Ltd., London, England, 1958. 232 pp., bound. 40s.)

Knicken Von Stahlbetonstaben Unter Kurz— Und Langzeitbelastung

The first section of this report on buckling of reinforced concrete describes a series of tests and evaluates the results; both short-time (1 to 2 hours) and long-time (from a few months to 2 years) tests were made. The second section provides a theoretical discussion of the results obtained. This is number 129 of the publications of the Deutscher Auschuss für Stahlbeton. (By Kurt Gaede. Wilhelm Ernst & Sohn, Berlin, Germany, 1958. 80 pp., paper, 24 DM.)

Plastic Design In Steel

Methods are given for designing continuous steel structures on the basis of their ultimate or plastic strength. The chapters contained deal with plastic theory applied to bending, effect of axial load on bending resistance, shear and web crippling, bracing requirements, non-symmetrical sections, haunched connections, design of continuous beams, design of single span rigid frames, and design of multi-span rigid frames. (Published by the American Institute of Steel Construction, 101 Park Avenue, New York 17, N. Y., 1959. 93 pp., bound. $4.00.)

Theory of Beams

Discusses the application of the Laplace Transformation method to the solution of the ordinary differential equations which occur in the theory of beams. Solutions are obtained for beams on two supports under various conditions of end fixing as well as for continuous beams both with rigid and elastic supports. In addition the author derives a solution of the differential equation of the elastic curve for the case of a beam with variable rigidity and defines the load function for this case. (By T. Iwinski. Pergamon Press, 122 East 55th Street, New York 22, N.Y., 1958. 85 pp., bound. $3.50.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or microfilm a copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

#3 HY-Q Sluice Gates Eliminate Interference with Flow

SPECIFY RODNEY HUNT HY-Q SLUICE GATES WITH FLUSH-BOTTOM CLOSURE and get these 6 design advantages

Silt and debris become trapped behind the vertical sill of a conventional sluice gate installation (Fig. 1)—or in the trough required for bottom wedges when the gate bottom is mounted flush with the invert. The Rodney Hunt HY-Q Sluice Gate, however, eliminates both these traps (Fig. 2). With every raising of the gate, the seating surface is flushed clear by the unobstructed flow.

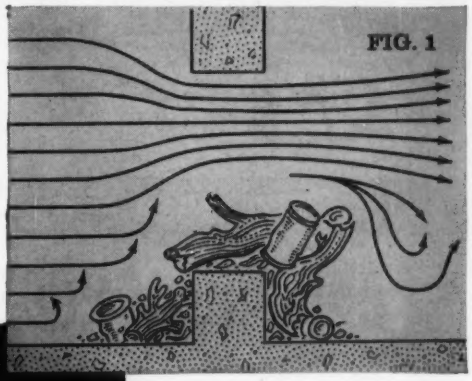


FIG. 1

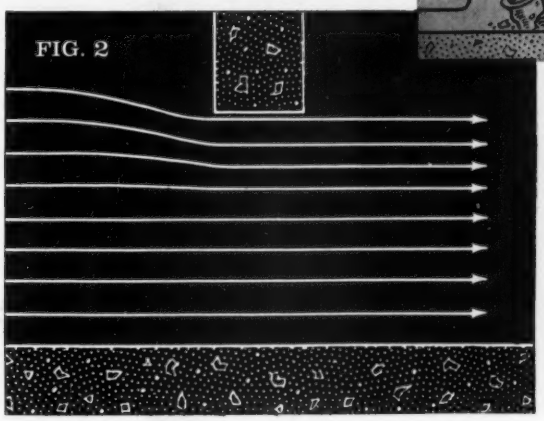
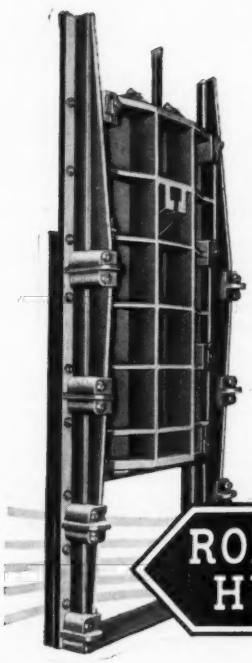
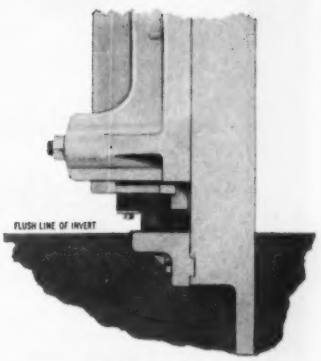


FIG. 2



The many advantages of the Rodney Hunt HY-Q Sluice Gate derive from the design of the resilient seal fastened to the bottom of the disc as illustrated at the right. This seal extends the full width of the disc and provides a cushioned closing at the stop bar *flush with the invert.* This flush-bottom closure assures—**1.** maximum flow—**2.** complete drainage without pumps or piping—**3.** elimination of silt and debris problems—**4.** maximum hydraulic gradient—**5.** lowest possible invert—and—**6.** construction economy.

In brief, the HY-Q gate offers unmatched design flexibility and construction economy for water control projects...with hundreds of gate sizes available from 6" x 6" to 144" x 144" and larger to meet your specific design requirements.



HY-Q The sluice gate with flush-bottom closure

RODNEY HUNT

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Serving water control engineers with equipment and engineering

New Publications

Drilling and blasting . . . . The marked advances of the past few years in drilling and blasting techniques are covered in the Proceedings of the Eighth Annual Drilling and Blasting Symposium. The symposium—held at the University of Minnesota in October 1958—was the first sponsored jointly by the mining engineering departments of the Colorado School of Mines, Pennsylvania State University, and the University of Minnesota. In the future annual symposia will rotate among the three schools, dealing in turn with the subjects of rock mechanics, exploration drilling, and drilling and blasting. Inquiries about the current volume should be addressed to the University of Minnesota, Center for Continuation Study of the General Extension Division, Minneapolis 14, Minn.

Highway research . . . . In its Highway Research Review series, the Highway Research Board provides a comprehensive listing of highway research projects in progress by state highway departments, federal bureaus, universities, and other agencies. Identified as Series 4B, the current issue includes all projects announced since publication of Series 4A as well as projects reported as completed or discontinued. Copies of the 220-page compilation sell for $4 each and are available from the Highway Research Board, Washington 25, D. C.

Air pollution . . . . The Proceedings of the National Conference on Air Pollution—held in Washington, D. C., in November 1958 under the auspices of the U. S. Department of Health, Education and Welfare—constitute a valuable reference in an area of ever-increasing concern to urban dwellers. The 526-page book is now on sale, at $1.75 a copy, by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Sewage treatment . . . . Sewage treatment contract award data since 1953 have been summarized by the Public Health Service in a bulletin identified as Publication No. 633. The authors are William H. Abbott, assistant sanitary engineer, and Lewis C. Hudson, Jr., statistician, for the Public Health Service. The bulletin, priced at 50 cents, may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Materials testing . . . . The American Society for Testing Materials announces issuance of its *1958 Book of ASTM Standards*. Published in ten parts, the reference evaluates millions of dollars worth of material. Specifically, the ten parts occupy 13,600 pages and contain 2,450 standard specifications, methods of test, definitions of terms, and recommended practices. Each part is complete with a detailed subject index and a list of standards in numeric sequence. The complete set is priced at $116. Inquiries should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

Water pollution control . . . . Sewage disposal practices in ocean waters, either estuarine or coastal, have been studied by the California State Water Pollution Control Board. The general objective of the project was the analysis and evaluation of existing and potential systems for measuring currents in such waters, as they relate to the movement, transport, and dispersion of discharged waste waters. Characteristics of both currents and measuring devices are now reported in State Board Publication No. 19, entitled "Investigation of Current Measurement in Estuarine and Coastal Waters." Copies of the report may be purchased from the State Printing Division, Documents Section, Sacramento 14, Calif., at $1.75 a copy. This cost includes shipping charges, but not the 7-cent sales tax that must be added for California addresses.

Airport development . . . . The airport needs of the United States in this jet age are set forth in "National Airport Plan—1959." This plan, the first to be developed under the Federal Aviation Agency, relates to the public, airport needs of all segments of civil aviation in the United States and its possessions for the 1959-1962 period. The comprehensive 504-page volume presents an objective appraisal of the nation's overall airport picture and recommends standards for design and construction. Its purpose is to "help assure the soundest possible national system of airports." The plan is not concerned with airport financing. Copies may be purchased from the Superintendent of Documents, Washington 25, D. C. at $4.75 each.

Highway research . . . . Several new references are available in the Highway Research Board's continuing series of publications. These include "Photogrammetry—Development and Applications: 1958" (Bulletin 199), which sells for $2.00; "Studies in Highway Administration" (Bulletin 200), priced at $1.00; "Rapid Tests for Aggregate and Concrete" (Bulletin 201), priced at 50 cents; and "Performance of Granular Subbases Under Concrete" (Bulletin 202), costing $1.60. Special Report 36, entitled "A Study of the Comparative Behavior of Friction Piles," sells for $2.40. Orders should be sent to the Highway Research Board, 2101 Constitution Avenue, Washington, D. C.

Treating radioactive water . . . . The effectiveness of water treatment processes in the removal of radioactive waste materials is evaluated in "Report of the Joint Program of Studies on the Decontamination of Radioactive Waters"—a document prepared by the Health Physics Division of the Oak Ridge National Laboratory and the Robert A. Taft Sanitary Engineering Center of the U. S. Public Health Service. The joint research conducted since 1950 indicates that the degree of removal of radioactive contaminants depends primarily on the chemical form of the contaminant and the particular treatment process used. Official requests for copies will be honored by the Public Health Service, Washington 25, D. C. To others the charge is $1.00, and copies should be ordered from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. The publication number is ORNL-2557.

Some Ideas

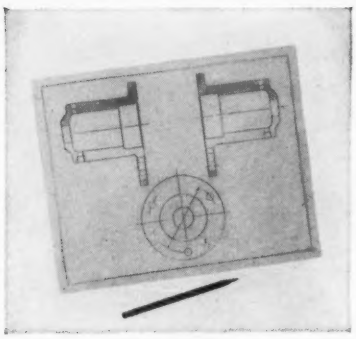
for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

A year of relentless testing has produced a small library of interesting facts about HERCULENE (T.M.) Drafting Film. What follows is a consensus of drafting-room experience with HERCULENE–by K&E and its customers–with some up-to-date recommendations for using it. Take the matter of . . .

Shiny Back vs. Pencil Back

A basic question is: do you need a double-surfaced drafting film? We make HERCULENE Drafting Film both ways, of course –with a single surface (shiny back) and double surface (pencil back). It's our recommendation that you use pencil back HERCULENE only if it's your practice to make basic drawings on one side, changes on the other. For most other uses, shiny back is preferable. (At first, the double-surface film was chosen by many drafting rooms because it lay flatter on the board than shiny back. This is no longer true. K&E research labs have come up with a fully effective anti-curl treatment.) Especially in filing, shiny back HERCULENE presents fewer problems. The clean non-abrasive back won't smudge the face of the sheet underneath, even in a heavy stack of tracings. If you'd like to compare a few sheets, please let us know.



Note sharp clear lines made by Duralar pencil on HERCULENE Drafting Film.

Plastic Pencils and the HERCULENE Surface

Not just a handy catch-phrase, when K&E puts its exclusive "engineered surface" on a drafting material, the result is an exact, uniform tooth for sharp pencil drawing, inking and typing. With HERCULENE Drafting Film, however, an entirely new type of plastic (non-graphite) pencil yields especially good results. Quite a few of our customers have reported favorably on the well-known Staedtler "Duralar" brand. Duralar pencils come in five hardnesses, are non-smudging and have generally good covering power, sharpness and erasability. After about 20 prints, the Duralar lines show up consistently better than those made by a regular pencil, since graphite lines tend to lose density.

Wet That Eraser!

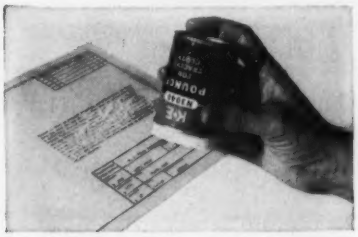
The erasing qualities of HERCULENE Drafting Film are excellent, but (as with the pencils) we've discovered it's a new type of vinyl eraser that gives the best results. Examples of these non-rubber type erasers are the Richard Best "TAD" and the Eberhard Faber "RACE KLEEN" – both available from your K&E dealer. With vinyl erasers, pencil lines whisk off. Even stubborn ink and typing can be removed easily, with no damage to the surface. Here's a tip on how to do this:

Moisten the eraser slightly. It becomes no more abrasive, but a lot more "erasive." Moistening is a must when removing Duralar lines or typing after exposure to heat. (Incidentally, don't use electric erasing machines, steel erasers or typewriter erasers.) When erasing large areas, certain chemical eradicators work fine too. Our suggestion: use Vythene or a very light application of a denatured alcohol such as Solox, both of which can be applied with a cotton swab or clean cloth.

The Cleaner the Better

HERCULENE Drafting Film was designed for ink work, and its ink take is unexcelled. But like all films, its non-absorbency makes a few preparations advisable. The surface should be cleaned thoroughly before inking. Quickest and most effective way to do this is with the ABC Draftsman's Dry-Clean pad, which will remove finger marks and "traffic film" simply by rubbing the pad over the surface. Pouncing will also work well. A damp cloth is all right for general cleaning, but does not do the best job of preparing the surface for ink.

Inking over graphite pencil lines comes out best when done over light lines, drawn with a harder grade of pencil. A good way to remove excess graphite is to go over the drawing with an ABC pad. Inks vary in their usefulness on HERCULENE. We've tested several, and you're welcome to these results as well, on request.



After Typing, Please Pounce

Typed impressions on HERCULENE Drafting Film are crisp and sharp, but may take a while to dry because the film's surface doesn't "swallow" ink readily. A light pouncing right after typing will dry the ink and fix the lines – giving you uniform permanent contrast.

A new typewriter ribbon will produce the best impressions. At K&E we've tested a healthy variety of ribbons and we'd be pleased to send you the results on request.

Outstanding Advantages Proved in Tests

We're pleasantly amazed at the short time it took for HERCULENE Drafting Film to become an accepted "staple" – along with ALBANENE® Tracing Paper and PHOENIX® Tracing Cloth. Actually, it's a rare drafting room by now that has *not* tested HERCULENE during its first year on the market. The findings: All properties considered, HERCULENE stands up better than any other drafting film. It has great resistance to heat, aging and abuse. Its exclusive "engineered surface" plus its tough, durable Mylar® base provide superior pencil and ink take, fine erasability, remarkable dimensional stability...a combination we're proud to call unbeatable!

The K&E dealer near you has HERCULENE now. Stop in and see him.

KEUFFEL & ESSER CO., Dept. CE-6, Hoboken, N. J.

Please send further information about HERCULENE Drafting Film. I'd like samples too.

Name & Title _____

Company & Address _____

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

Men Available

STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E. and M.S., age 34. Three years' heavy industrial design, two years' commercial design and three years' hydraulic structures. Location desired: South or Southwest. C-434.

CIVIL ENGINEER, Student Member ASCE; will receive B.C.E. in June, 1959; age 28. One year experience drafting, steel detailing, design and quantity take-off; two years' construction surveying on highways and heavy construction, including supervision and inspection; three and one half years' traffic engineering in responsible position as engineer-in-charge of municipal parking meter program. Desires position as civil engineer on highway or heavy construction project. Available immediately after graduation. Location desired: Foreign. C-435.

DESIGNER, Structures, Student Member ASCE, M.S.E.; age 26; eighteen months' experience in the design of structures. Location optional. C-453.

ENGINEER, Student Member ASCE, M.S.E.; age 27. Design of bridges, 3 months; construction of weir and head regulators and buildings (with new construction company in Bombay, India), three years. Location optional. C-454.

PROFESSOR or responsible position with architect or engineers, M. ASCE, Ph.D.; age 38. Fifteen years of experience in administration, design and research—commercial and industrial buildings, power plants, waterfront structures and heavy foundations. Author of technical book and papers. Location immaterial. C-457.

PROFESSOR, A.M. ASCE; Master's degree; age 36. Six years of teaching structural engineering and ten years of industrial experience in bridge, building and foundation design. Some recent publications. Desires teaching position. C-458.

PROFESSOR, Hydraulic Engineer, M. ASCE; age 56. Five years' teaching; twenty years' planning, design and construction of floor control, irrigation and other hydraulic work; four years' multi-purpose basin development project planning. Desires teaching position or planning work. Location preferred, U. S. or South America. C-459.

SANITARY ENGINEER, A.M. ASCE; M. AWWA, APHA, FSIWA, ASTM&H, Delta Omega; certified, ASEISB; B.S.C.E., M.S.; licensed home state; age 42. Six years with state health department reviewing water and sewerage plans and operation of plants; one year of undergraduate sanitary engineering teaching (part time); eleven years of foreign experience in eight countries with international health agency, principally as adviser to governments. Available February 1, 1960; interviews possible midwest U. S. early July, 1959. Location desired, U. S. C-460.

CIVIL ENGINEER, A.M. ASCE; B.S.C.E., V.P.I., 1951; registered in Virginia; age 32. Eight years' varied design, construction, sales and management experience. Interested in challenging structural design position or responsible sales position selling engineered products. Available immediately. Will relocate. C-461.

CHIEF ENGINEER, M. ASCE; registered in nine states. Over twelve years' design and construction of highways, airports. Incidental experience in home design, sewerage design and construction, docks and general civil engineering practice. Proven ability in organizing and supervising engineering office. Familiar with current practices and specifications of several eastern states. C-462.

ENGINEER-GEOLOGIST, A.M. ASCE; B.S.E., M.S.; age 32. Eight years' experience ground-water development for industrial and municipal water supply, environmental hazards evaluation for nuclear plants. Geophysical and hydraulic testing methods used. Subsurface soil studies, ground-water recharge, design of well fields, interpretation of radiologic monitoring data. Supervisory experience. C-463.

STRUCTURAL DESIGNER, J.M. ASCE; B.S. and M.S. in C.E.; age 26. Four years' in bridge and highway design; two and one half years' in teaching as a part time instructor; six months' in microwave surveying and tower design; six months' in steel fabrication and three months' in research. Location desired: East or West Coast. C-464.

STRUCTURAL DESIGNER, Field-Bridges, Highways: J.M. ASCE; C.E.; age 26. Two and a half years' experience as structural designer for railroad and highway bridges, viaducts, structures, detailing; consulting engineers. Salary $6,500. Prefer West. SF(M)-1986.

STRUCTURAL DESIGN-CONSULTING ENGINEER: C.E.; age 24. One and a half years' design, detail bridges, consulting engineer; one year as inspector, title searcher, deeds interpretating; highway department. Salary, $500-600 per mo. Prefer North, Southern California. SF(M)-1956.

FIELD OR OFFICE ENGINEER—Construction, City, or Plant: A.M. ASCE; C.E.; age 39. Looking for chance to transfer back into construction work; two years' civil engineering for railroad and one year bid estimates on general building, plus ten years' field and office studies, reports and recommendations relating to water supply systems, city planning and degree of risk for insurance ratings in municipalities. Prefers San Francisco area. SF(M)-1902.

DESIGN—HEAVY STRUCTURES AND BUILDINGS: J.M. ASCE; C.E.; age 30. Five years' design and layout mine equipment, coils, hydraulics, structural, construction on smelter, refinery and acid plant buildings, facilities and equipment for a mining company; one year electrical utility facilities design; one year field engineering on off-shore oil structures. Salary, $7,000. Prefers San Francisco or Denver areas. SF(M)-1807.

DESIGNER—STRUCTURALS: A.M. ASCE; M.S.C.E. (Denmark); Registered Civil and Licensed

Structural in California; age 31. Four years' chief structural, design, planning, administrative and supervision of staff for architect-engineer; two years' senior design and design drafting, computing and checking on utility hydro-power plant. Salary, $8,000 up. Prefers Foreign. SF(M)-1841.

COMPTROLLER OR OFFICE MANAGER—ENGINEERING BUILDER: A.M. ASCE; C.E.; age 37. For five years was head of budget and cost control and principal assistant to chief engineer, concerned with budgets, cost controls, contracts, engineering scheduling and progress, estimates for engineering builders; three years' directing civil works construction and maintenance for government; three years' townsite design and office engineering, surveys and computations for government. Salary, $12,000. Prefers Western U.S. or Foreign. SF(M)-1839.

DESIGN, TEACH—STRUCTURAL, CONCRETE: M.S. Structural Engineering; age 38. Nine years' city engineer; two years' municipal designs, field controls and surveys; two years' office and field engineering and drafting for railway. Salary, $6,000 up. Prefers U.S., Canada or Mexico. SF(M)-1833.

GENERAL CIVIL ENGINEERING—PUBLIC WORKS: C.E.; age 24. Several years' office and field on missile range construction for the federal government. Salary, $550 up per mo. Prefers western U.S. SF(M)-1788.

SUPERVISORY ENGINEERING—HEAVY CONSTRUCTION: M. ASCE; licensed C.E., age 63. More than 30 years' consulting, designing, estimating, constructing hydro projects, military bases, airports, oil developments, highways, bridges, oil field drilling and development. Salary, $6,000 up. Prefers California or Foreign. SF(M)-1849.

ARCHITECT OR DIRECTOR OF ENGINEERING—large public or private firm: A.M. ASCE; C.E.; licensed California architect; age 46. Three years' job supervision multi-story buildings, churches, schools, commercial buildings; three years' chief design, steel timber, concrete structures for a structural engineer; there years' consultant for public and private buildings; two years' structural engineer for city. Salary. $750-950 per mo. Prefers Western U.S. SF(M)-950.

SUPERINTENDENT OR MANAGER, heavy construction; J.M. ASCE; C.E.; age 35. Two years as general manager on heavy construction, highway, bridge; five years as chief construction engineer for steam generators erection and installation; three years as resident and construction engineer on draw bridge, warehouses, town water line installation for public works department. Salary, $14,000. Prefers Sacramento or Northern California. SF(M)-1738.

DESIGN OR ASSISTANT SUPERINTENDENT, structural, general construction; A.M. ASCE, C.E.; Licensed Structural; age 46. Six years' design, draft, check office building, hospitals, schools, commercial for consultants and city; six years' field office inspection and design on commercial buildings, wharf and dock, municipal work, quantity take-off for city, consultants and contractors; eight years' geological and hydrographic chief of party. Salary, $850 per mo. Prefers San Francisco area. SF(M)-1613.

ASSOCIATE PROFESSOR, Soils, Civil; A.M. ASCE; Ph.D. (soil mechanics and structures); age 36. Five years as instructor and lecturer in civil engineering, soil mechanics, structural and foundation engineering for missiles, structural for buildings and industrial plants, bridges for state and miscellaneous aircraft design. Salary, $750 up per mo. Prefers West or Midest U.S. SF(M)-1576.

DESIGN, RESEARCH OR TEACH, Construction, Steel, Civil; J.M. ASCE; M.S.C.E.; age 36. Four years' analysis of determinate and indeterminate steel bents; three years' teaching; four years' design, draft. Salary, $750. Prefers San Francisco SF(M)-1731.

Positions Available

STRUCTURAL ENGINEER, Master's or Ph.D. degree, with considerable experience, for a prominent consulting engineering firm. Location: Midwest. W-6726.

STRUCTURAL ENGINEER, civil graduate, with about ten years' design experience covering industrial buildings and considerable power plants. Salary, $10,000-$12,000 a year. Location: New York, N. Y. W-7025.

(Continued on page 139)

Positions Announced

Oregon State Civil Service Commission. Vacancy exists for Chief Industrial Hygiene Engineer, $6,900 to $8,580, to supervise occupational health program for the state. Must have five years' experience in supervisory or advanced technical assignments in industrial hygiene and possess a master's degree in industrial hygiene engineering. Applicants must be eligible for registration as a Professional Engineer in Oregon at the time of appointment. Apply: Oregon Civil Service Commission, Public Service Building, Salem, Ore.

United States Civil Service Commission. There is an urgent need for highly qualified Engineers—Aeronautical, Electrical, Chemical, Electronic, Mechanical, General and Industrial, $4,490 to $12,770. The positions to be filled are located at Huntsville, Ala., with the Redstone Arsenal, where research, development and industrial activities of rocket, missile and satellite programs, plus the support of missile systems in the field are carried out. Applications will be accepted by the Board of U.S. Civil Service Examiners, Redstone Arsenal, Ala., until further notice.

City of New York. A number of openings for Civil Engineers, including specialists in building construction and water supply, are available with various city agencies. Starting salary is $7,100 a year, with annual increases up to $8,900. Applicants must have a civil engineering degree from an accredited college and six years' experience in design or construction work—high school graduates with ten years of experience will be considered —and must hold a N. Y. State Professional Engineer's License. Application forms and full information about the civil service examinations may be had by contacting Arnold deMille, Director of Recruitment, New York City Department of Personnel, 299 Broadway, New York 7, N. Y., before June 19th.

Public Health Service. A limited number of traineeships in the field of air pollution will be awarded to individuals desirous of obtaining such specialized training and instruction during the 1959-1960 academic year. A trainee must be a citizen of the U.S. or have filed a Declaration of Intent and must hold at least a bachelor's degree or the equivalent and be accepted for admission by an educational or training institution offering a recognized degree before applying for a grant-in-aid under this program. Regular annual stipends are: Post-doctoral trainee, $4,800; Post-master's trainee, $3,600; and Post-bachelor trainee, $3,000. In addition there are allowances for dependents, travel, and school tuition and fees. Applications may be secured from any of the Regional Offices of the Public Health Service, or from the Chief, Division of General Health Services, Public Health Service, Washington 25, D. C.

Applications for Admission to ASCE, March 28-May 2, 1959

Applying for Member

HARRY BENJAMIN ANTELL, Haddon Heights, N. J.
HEIMO OLAVI ARPONEN, Helsinki, Finland
STANISLAW MICHAL BALA, San Rafael, Calif.
BJORN BARMEN, Newburgh, N. Y.
ERWIN S. BESSERER, Peoria, Ill.
ARCHIE CROZIER BLACKBURN, Freeport, Tex.
JOHN BUFORD CARTER, Baton Rouge, La.
JOHN J. CASTANIA, Boston, Mass.
EDWIN FREDERICK CLARK, Albany, N. Y.
WILLIAM KENNERLEY CLAWSON, Ontario, Canada
ROBERT EDWARD CURLEY, Honolulu, Hawaii
HOWARD HENRY DAVIS, Ogden, Utah
MICHAEL DEMEO, New York, N. Y.
ALFRED FRANCIS DIENER, Gary, Ind.
HENRY WARD DOUGHERTY, Memphis, Tenn.
CLIFFORD VALMORE ECKHARDT, Washington, D. C.
ERIC LEROY ERICKSON, Washington, D. C.
ROBERT EUGENE FISH, Milford, Pa.
OSCAR FRANK FRIED, Miami, Fla.
JOSEPH DANIEL GILFOYLE, Pittsburgh, Pa.
EUGENIO GONZALEZ, Moron, Venezuela
WILLIAM GROTHAUS, Massena, N. Y.
SAMUEL CLINTON HAMILTON, Chicago, Ill.
ROBERT OWEN HAYES, Wilmington, Del.
MIKLOS HETENYI, Evanston, Ill.
WILLIAM ROSS HUNT, Indianapolis, Ind.
SYED IRSHAD HUSAIN, Lahore, Pakistan
MULJI JAYRAM KAKKAD, Ahmedabad, India
MUNTHER KHATIB, Beirut, Lebanon
ROBERT KRAFFENBAUER, Mommsengasse, Austria
WILLIAM CHARLES KRELL, Lansing, Mich.
ERLING LIEBERG, Boston, Mass.
ALFRED LIFF, Los Angeles, Calif.
JOSEPH TSO-TI LING, Minneapolis, Minn.
DONALD MACDONALD III, Fairbanks, Alaska
ROBERT FULTON MAHAFFEY, Toledo, Ohio
CHARLES BUCK MALCOLM, JR., Roanoke, Va.
ROBERT WILLIAM MAECROFT, JR., Boise, Idaho
ARMANDO MARTELLI, Dallas, Tex.
EMILE MASSABNI, Beirut, Lebanon
CHARLES ERNEST LOUIS MASSONNET, Liege, Belgium
JOHN NIKOLAS MATICH, Colton, Calif.
LYLE HARTMAN MELIZA, Peoria, Ill.
ANTONIO TOMAS MOLINI, Rio Piedras, Puerto Rico
DAVID SUTPIN MOORE, Novato, Calif.
CHRISTOPHER JOSEPH MURPHY, New York, N. Y.
HORST MULLER, Windhoek, South West Africa
EDWARD GEORGE NAWY, Cambridge, Mass.
MERLE WELDON NICEWANDER, Highland, Ind.
GEORGE FRANKLIN NOBLE, Chicago, Ill.
THOMAS POLI, Baldwin, N. Y.
LELAND ROBERSON POST, Binghamton, N. Y.
WILLIAM FRANCIS POWERS, Philadelphia, Pa.
EDWARD FELIX POWALSKI, Buffalo, N. Y.
ROBERT JOHN REESE, State College, Pa.
EARL ROY REUSCHEL, St. Louis, Mo.
GILBERT GAIL ROLLSTIN, McCook, Nebr.
ROBERT JOHN ROONEY, Sacramento, Calif.
MURRAY JOHN RUTHERFORD, Richland, Wash.
BRADFORD SALVETE, Quincy, Mass.
WALTER WAYNE SAXTON, Seattle, Wash.
BILL SHOPE, Los Angeles, Calif.
JAMES RICHARD SPIRZ, Auburn, Calif.
R. C. STEELE, Tulsa, Okla.
JESPER CHRISTEN STRANDGAARD, San Rafael, Calif.
PAUL HENRY SYMBOL, Walla Walla, Wash.
BIR SAIN TALWANI, Roorkee, India
SAMUEL TARADASH, Youngstown, Ohio
JAMES PORTER TAYLOR, Knoxville, Tenn.
HUGH JOHN TENNENT, Victoria, B. C., Canada
REGINALD CAMERON THURBER, Victoria, B. C., Canada
JAMES HAROLD TILLMAN, El Paso, Tex.
HARRY JOHNSON WEAKS, JR., Cincinnati, Ohio
GEORGE BOYD WESLER, Chicago, Ill.
FRED HUBBARD WILSON, Jacksonville, Fla.
WALTER LLOYD WINEGAR, Portland, Ore.
LOUIS EARL WINKELHAUS, Ann Arbor, Mich.
GEOFFREY WOOD, London, England

Applying for Associate Member

NOEL RALPH ADAMS, Tacoma, Wash.
GEORGE GUST ASSURAS, Reno, Nev.
RENE AUDY, Montreal, Canada
BILLY NEILL BANISTER, Corpus Christi, Tex.
RICHARD WESTON BARNETT, Lincoln, Nebr.
CORNELIS VAN BEESTEN, Selangor, Malaya
ERNESTO BLASCHITZ WIESE, Caracas, Venezuela
JERRY RAY BOHANNAN, Albuquerque, N. Mex.
ALFRED HENRY BOLDTMANN, JR., Baltimore, Md.
STEFAN ALFONS BOREK, Montreal, Que., Canada
DAVID CADDEN, Baghdad, Iraq
CESAR ALMIREZ CALIWARA, Chicago, Ill.
STEPHEN JOSEPH CANTY, San Antonio, Tex.
JOHN MICHAEL CARNEY, Tacoma, Wash.
ROMEO ERNEST CARTIER, JR., Hartford, Conn.
PETER WILLIAM CASEY, Hollywood, Calif.
HAROLD ARTHUR CLOUD, Chicago, Ill.
JAMES HOY CONWAY, Seattle, Wash.
FRANK JOSEPH COSTELLO, West Nyack, N. Y.
LEWIS CLEAVER CRAWFORD, Salina, Kans.
ARTHUR ALAN DELLAPA, East Orange, N. J.
CARMIN JOHN DEVITO, Newark, N. J.
BENJAMIN TOLMAN DIBBLE, Phoenix, Ariz.
EMMETT EZRA DUSHARM, Topeka, Kans.
GRAY EDWARDS, Roselle, N. J.
DONALD ROBERT FIX, Fullerton, Calif.
CHARLES WILEY FOSTER, Tuscaloosa, Ala.
JOSEPH SAMUEL FRAGOMENI, SR., South Bend, Ind.
FRANCIS BACON FUGATE, Dhahran, Saudi Arabia
JOSE SAMUEL GARCIA, El Paso, Tex.
DALE ROLAND GATLIN, San Jose, Calif.
RICHARD GEORGE GODFREY, Washington, D. C.
DONALD WILSON GRANT, Seattle, Wash.
ALBERT GRIFFIN, Birmingham, Ala.
DONALD ROTH GRUNAUER, New York, N. Y.
ROBERT BALLANTYNE HAIGHT, Fairbanks, Alaska
NORMAN WALTER HANSON, Chicago, Ill.
THEODORE JOSEPH HARRIS, Appleton, Wis.
WAYNE CHARLES HART, Baltimore, Md.
JOHN HOPKINSON HAYES, Teheran, Iran
WILLIAM ZOLTAN HEGY, Sacramento, Calif.
DAVID BENEDICT HILL, New York, N. Y.
JAMES EMERSON HOUGH, Frankfort, Ky.
HWEI-YANG HSI, Detroit, Mich.
ROBERT HENRY HUDSON, Sacramento, Calif.
RONALD LEE HUTCHINSON, Cincinnati, Ohio
MARVIN ELI JENSEN, Fort Collins, Colo.
CARL ROBERT JOHNSON, Des Plaines, Ill.
HAROLD DEXTER JONES, Houston, Tex.
WILLIAM EDWARD KENNER, Ocala, Fla.
HIONG JU KIM, Pusan, Korea
JAMES EDWARD KINDIG, Hayward, Calif.
JOSEPH AUGUST KLEINE-KRACHT, Louisville, Ky.
JAN KAROL WIKTOR KOMOCKI, Montreal, Que.
ELJA RAIMO ASLAK KUORIKOSKI, Helsinki, Finland
NAVIN CHANDRA LALJIBHAI RUPANI, Springfield, Ill.
EGON LAZARUS, New Orleans, La.
HARRY EINO LINDELL, New York, N. Y.
EDWIN CLARION LOKKEN, Kansas City, Mo.
WILLIAM DENNISON LLOYD, Anchorage, Alaska
DANIEL LEWIS LYCAN, Decatur, Ill.
IAN MATHESON MACKENZIE, London, England
NORMAN GERDES MARKS, Pittsburgh, Pa.
DANIEL PAUL MAXFIELD, New York, N. Y.
JAMES MCCUNE, Concord, N. H.
RICHARD JOHN MCDAID, Wooster, Ohio
KENNETH EDWIN MCINTYRE, San Francisco, Calif.
WALTER EDWARD MERCER, Cloverdale, B. C., Canada
DANIEL MEYER, Rolla, Mo.
ROGER DALE MILLER, Columbus, Ohio
ROBERT KENNETH MORSE, Urbana, Ill.
OSWALDO ALFONSO MOSQUERA MOLINA, Los Angeles, Calif.
ROBERT MELVIN NICHOLS, Tacoma, Wash.
ROBERT LEO NORD, Louisville, Ky.

DONALD EDWARD OBAZEM, Bellingham, Wash.
JAMES PATTERSON, Buffalo, N. Y.
ROGER LEE PENDLETON, Arlington, Va.
RALPH MAX PETERSON, Revere, Mass.
YING-BIU POON, Hong Kong, China
JAMES SMILEY PORTER, Charlotte, N. C.
PAUL WILLIAM PRENDIVILLE, Boston, Mass.
HENRY PUNDLEIDER, Ontario, Canada
FRITZ WILHELM RECHTERMANN, Evergreen Park, Ill.
WILLIAM CLARE ROEGE, JR., Jackson, Mich.
SAGHAYROON EL ZEIN SAGHAYROON, Republic of the Sudan
HENRY EDWARD SANDAHL, Olympia, Wash.
JOHN JAMES SCHMIDT, San Jose, Calif.
DONALD CAMERON SEITZ, La Puente, Calif.
VERNON EVERETT SHELDON, JR., Helena, Mont.
KUO YU SHEN, Singapore, Malaya
CHARLES ANDREW SMITH, JR., New York, N. Y.
ZOLTAN ALADAR SZENTMARTONY STACHO, Denver, Colo.
ROGERS N. STRICKLAND, Tulsa, Okla.
MYRLE ARNOLD STROHBEHN, Houston, Tex.
WALTER IRA STRONG, Syracuse, N. Y.
GUY W. SWARTWOOD, Kansas City, Kans.
EDWIN MCLEARN THURMOND, Denver, Colo.
JAMES WARREN TOLLADAY, Atwater, Calif.
WILLIAM WAYNE TRAINER, Chicago, Ill.
NORMAN HAROLD TRAVES, Queensland, Australia
ANDRE MAURICE TRECOURT, Haute Alpes, France
CARLOS ALBERTO VIALE, New York, N. Y.
MILLE VON, Richmond, Va.
OMKAR NATH WAKHLU, Roorkee, India
SAMUEL MASON WALDEN, Caracas, Venezuela
WALTER GEORGE KANELEI WILCOXSON, San Diego, Calif.
WILLIAM SCHUYLER WOOD, Pittsburgh, Pa.
DONALD ARTHUR WRIGHT, SR., Salt Lake City, Utah
RINGOLDS ZEIDAKS, Olympia, Wash.
JOHN JULIUS ZEKUNY, Los Angeles, Calif.
CHARLES HILL ZINN, Sacramento, Calif.

Applying for Affiliate

PHILIP EUGENE BALCOMB, Naperville, Ill.

Applying for Junior Member

GEORGE RUSSELL ALGER, Brookings, S. Dak.
FLAVIO PINHEIRO AVILA, Sao Paulo, Brazil
RONALD ERNEST BECKER, Lafayette, Ind.
WILLIAM KRUSE BIELENBERG, Valley Stream, N. Y.
ALAIN MCMILLAN BREYTON, Los Angeles, Calif.
ROBERT COLLINS BRINEY, Sacramento, Calif.
THEODORE OLAF BROWN, Richland, Wash.
ANTHONY BERNARD CAMPITELLI, Baltimore, Md.
RUDOLPH VINCENT CANTARINI, Coral Gables, Fla.
VERNON EDWIN CARLSON, Chicago, Ill.
PHILLIP TUNG CHEN, Cleveland, Ohio
SEH-IEH CHOU, Brookings, S. Dak.
ROBERT JOSEPH CONLON, Urbana, Ill.
GERALD FRANCIS COX, Saskatoon, Sask. Canada
DEVERE JESSE DAVIS, Sacramento, Calif.
NATHANIEL TERRY DICKEY, Birmingham, Ala.
ROBERT KEYES GABRYSCH, Cuero, Tex.
ANDRE ROBERT GAGNON, Cambridge, Mass.
HARRY STANLEY GREENBERG, New York, N. Y.
RAMON GUEMEZ-GARCIA, Urbana, Ill.
JAMES WALLACE HUBBELL, Birmingham, Mich.
JOHN EDWARD HURST, Mobile, Ala.
DONALD REED JAMES, Santa Clara, Calif.
JORGE CAUAS LAMA, Washington, D. C.
FRANK MALLORY LEMON, Little Rock, Ark.
ANTHONY FRANK LISANTI, North Chicago, Ill.
VERNON FRANCIS MACHADO, Los Angeles, Calif.
WANG-KWONG MAK, London, England
JOSEPH CARL MARTON, Canton, Ohio
MANGALDAS KANJI MEHTA, Bethlehem, Pa.
YUEN KAI MENG, Victoria, Australia
JOHN LEWIS MIHELICK, Cuyahoga Falls, Ohio
WILLIAM GEORGE CAMPBELL MURDIE, Jackson, Mich.
CALVIN KENNETH MYERS, Harrisburg, Pa.
HARLEY RICHARD NEILL, Long Beach, Calif.
LIN-FAI NG, Los Banos, Calif.
HARALD NIELSEN, Nashville, Tenn.
GLENN ELLIOTT NOBLE, Pontiac, Mich.
FRANCIS PANDULLO, Westfield, N. J.
CHHOTUBHAI BHIKHABHAI PATEL, Urbana, Ill.
MANUBHAI CHATURBHAI PATEL, Bethlehem, Pa.
FRANK LEWIS PONSFORD, El Paso, Tex.
PETER PAUL QUIMBY, Philadelphia, Pa.
SIRAJUL HAQ QURESHI, Karachi, Pakistan
KRISHAN KUMAR SAIGAL, Cleveland, Ohio
ARMAGAN SANVER, Durham, N. C.
RONALD JAMES SAUNDERS, Youngstown, Ohio
REINHARD SCHNEIDER, Giessen, Germany
ERNEST THEODORE SELIG, Chicago, Ill.
VAUGHN LEE SHAHINIAN, San Jose, Calif.
SATYA SAGAR SHARMA, Urbana, Ill.
CORNELIUS CHUNG-SHENG SHIH, Lansing, Mich.
STANLEY SEIZUN SHIMABUKURO, Honolulu, Hawaii
THOMAS WORTH STEWART, Corpus Christi, Tex.
RICHARD ARTHUR SULLIVAN, Cambridge, Mass.
PUSHPAKANT BHAGWANDAS THANAWALA, Urbana, Ill.
GUSTAVO TORRICO, W. Lafayette, Ind.
STEPHEN WAYNE TUCKER, San Francisco, Calif.
JOHN EDWIN VAN DELL, Colton, Calif.
DAVID ARTHUR YATES, Seattle, Wash.
HARRY DONALD YORSTON, San Francisco, Calif.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

ESPS

(Continued from page 135)

ARCHITECTURAL ENGINEER, with eight to fifteen years' experience in industrial office, laboratory and factory. Must be registered. Salary open. Location: Midwest. W-7134.

DEVELOPMENT AND DESIGN ENGINEER, B.S. in mechanical or civil, with excellent grasp of stress analysis and hydraulics; familiarity with machine shop and foundry practice desirable. Five to ten years' experience desirable. Will head up a small development and design group. Salary, about $9,000 a year. Location: New York, N. Y. W-7400(a).

WASTE TREATMENT SALES MANAGER, sanitary or chemical engineer, with a minimum of five years' experience in the water conditioning industry, preferably in waste treatment or sewage treatment. Will be responsible for planning and control of the marketing and sales functions, customer contacts, indoctrination of field personnel. Salary, $14,000-$16,000 a year. Location: New York, N. Y. W-7403(a).

DESIGNERS for structural engineering department of a firm of architects-engineers; junior, senior designers and design draftsmen and draftsmen. Salaries open. Location: South. W-7407.

INSTRUCTOR for civil engineering department, with Master's degree, to teach reinforced concrete and related subjects. Will consider applicant with no experience. Salary, to $6,500 for nine months. Available September 1959. Location: Midwest. W-7413.

PRODUCT MANAGER, civil or structural engineering graduate, with at least five years' estimating and field sales experience covering roof decking or allied products. Some traveling. Salary, $7,200-$7,800 a year. Location: Midwest. W-7415.

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Trucks Used on Dam Construction

FORTY-FIVE MOTOR TRUCKS, ranging in size from A-100 and A-112 pickups and Travelalls to hefty, diesel-powered RDF-411 multi-purpose extra heavy-duty transports, are being used to fuel, grease and otherwise service Payhaulers, draglines, shovels and crawlers at work in the construction of the Glen Canyon Dam.

The wheeled applications on this sprawling oasis appear unlimited. Observed in operation are: RF-195 water trucks; A-120 and A-162 models on drilling and blasting; ACF-172 lube rigs; mobile mechanical shops which ride the A-162 chassis; A-160 welding trucks and others mounting frame hoists for steel hauls; AC-182 gasoline tankers and flat-rack-fitted A-162 trucks. Added to those named are two A-120 4 x 4 Travelalls supporting Merritt-Chapman & Scott Corp. first aid service.

Lube Rig

To service the fleet working at the river level, the contractor uses a 40-ton capacity highline to lower the lubrication trucks 700 ft from the rim to the canyon floor where spillways and diversion tunnels are being built. —CE-1

All-Steel Forms

FORM SETTING TIME AND COSTS have been reduced in construction of 6,000 ft of diversion and spillway tunnels at Glen Canyon Dam through use of all-steel nontelescopic forms that are highly accurate and mobile.

At the present time, two 60-ft-long nontelescopic form sections with a 41-ft "A" line are in use. One additional 40-ft section is being assembled and scheduled for use within the next few months.

In placing tunnel concrete, the first and most important factor to a contractor, as concerns forms, is accuracy, it is stated. The forms must conform—and do it consistently—to established grades, or finished inside diameter, regardless of the number of times they are set and reset for successive pours.

Another requirement of the forms for Glen Canyon Dam tunneling work is a special design that permits lining curved or tangent sections within a radii as small as 165 ft, as well as inclined sections.

Mobility is achieved by mounting the forms, preassembled outside the tunnel, on rails secured to the previously poured invert or bottom section of tunnel. Moved into concrete pouring position, a series of hydraulic jacks at the base of each section of forms expands the unit to match "A" line grade.

A wooden bulkhead is employed at the front end of the pour section. Concrete is placed with a Pumpcrete machine, vibrated to eliminate honey-comb and cured 16 to 24 hours. When hydraulic pressure on jacks is released, the unit is partially collapsed and moved to a position for the next pour and hydraulic jack pressure reapplied. This consumes only 12 hours. —CE-2

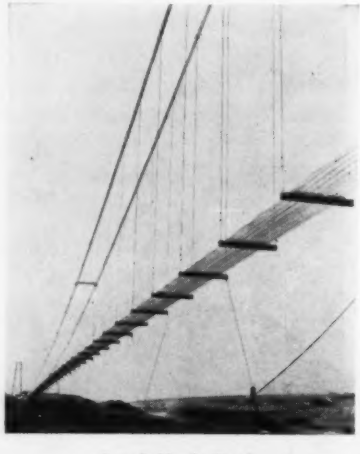
Bridge Strand Used to Construct Footbridge

SEVEN HUNDRED FEET ABOVE THE Colorado River, at the Glen Canyon Dam site in northern Arizona, is what is thought to be the longest footbridge in the United States.

Designed as a walkway for project employees only, it provided ready and quick access to both sides of the river during construction of the main arch bridge. A suspension span, it extends 1280 ft from tower to tower. All material for the footbridge, except the structural steel for the towers, was furnished by the company's Bridge Division.

Completed in 60 days, the bridge features a steel mesh deck to reduce wind resistance. Construction was started by lowering two ⅝-in. cables to the bottom of the west side of the gorge, transporting them across the river by boat and raising them on the east side by block and tackle.

The six main suspension cables are 1¾-in. dia prestretched galvanized bridge strands, from which are hung sixty-four ⅝-in. suspenders, attached to 7-ft wide floor beams. The wire mesh floor is laid on eight 1-in. dia deck cables; these in turn are supported every twenty feet by the floor beams. For safety, four handrail cables are attached to the suspenders. To add stability in strong winds, two 1¾-in. bridge strand wind brace cables run below the deck on either side for its entire length. —CE-3



Steel Mesh Deck

Excavators Used On Dam Construction

EIGHT EXCAVATORS ARE CONTRIBUTING TO the digging efficiency needed on the Glen Canyon Dam project. Four big 4-yd

Type 111-M Shovel

Type 111-M shovels, a 3-yd Type 101-M, a 1½-yd Type 362 and two 40-ton Type 43-M truck cranes are aiding in the moving of almost four million yards of materials.

The shovels, totaling 33½ yd in capacity, are helping to carve keyways in the vertical walls of the rocky canyon which will serve as anchors for the dam. Both of the 43-M truck cranes use dragline buckets to assist in the general excavation work but their main purpose at the site is plant construction and material handling. A number of steel storage yards have been set up to handle the 10,700,000 lb of reinforcing steel and 4,250,000 lb of structural steel required in the construction of the dam. The 43-M truck cranes do much of the steel handling.

When the 220-tph aggregate plant was set up 6 mi from the construction site, the truck cranes were used for the erection. The capacity of the plant will be increased nine times in size when concrete pouring gets underway later this year. —CE-4

SPECIAL! WITH THIS ISSUE . . .

ENGINEERS' INFORMATION SERVICE

As a possible further service to our readers we are testing a new system which will greatly simplify the procedure for obtaining additional data on advertised products, new developments reported by manufacturers in "Equipment, Materials and Methods, Literature Available and Films Available." Instead of writing separately to each manufacturer, you need only circle the items you would like to receive on the coupon printed below and mail it to:

ENGINEERS' INFORMATION SERVICE
CIVIL ENGINEERING
33 West 39th Street ▪ New York 18, New York

For information on products advertised in this issue, circle the appropriate page number on the left-hand coupon; for items listed in "Equipment, Materials and Methods, Literature Available and Films Available," circle the appropriate key number listed on the right-hand coupon. In addition to your name and address, be sure to include your title and firm name on the coupon. All information will be sent directly to you from the manufacturers.

June 1959—Products Advertised

ENGINEERS' INFORMATION SERVICE *Date*.....
CIVIL ENGINEERING
33 West 39th Street
New York 18, New York

PLEASE SEND me more complete engineering information on the products advertised in the pages circled below.

IFC	24	96, 97	131	151	160R
1	25	99	132,133	152T	161T
2	28	101-8	135L	152B	161B
4, 5	29L	109	135R	153L	162L
6	29R	115	136	153R	162R
7	30	117	137TL	154T	163T
8, 9	31	119	137TR	154B	163B
12	32, 33	120	137B	155	164TL
13	34, 35	121	138	156	164BL
14, 15	36, 37	124	139	157	164TR
16	38, 39	125	142	158L	164BR
17	40	126	143	158TR	165
18, 19	42	127	144	158BR	IBC
20	44	128	145	159	OBC
21	91	129	146	160TL	
22, 23	93	130	150	160BL	

Note: **The following code identifies the location of the ad when more than one advertisement appears on a page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.**

Name .....
Title .....
Company .....
Address .....
City, Zone and State .....

June, 1959—Equipment, Materials, Etc.

ENGINEERS' INFORMATION SERVICE *Date*.....
CIVIL ENGINEERING
33 West 39th Street
New York 18, New York

PLEASE SEND me more complete engineering information on the items featured below.

CE-1	CE-10	CE-19	CE-28	CE-37	CE-46
CE-2	CE-11	CE-20	CE-29	CE-38	CE-47
CE-3	CE-12	CE-21	CE-30	CE-39	CE-49
CE-4	CE-13	CE-22	CE-31	CE-40	CE-50
CE-5	CE-14	CE-23	CE-32	CE-41	CE-51
CE-6	CE-15	CE-24	CE-33	CE-42	
CE-7	CE-16	CE-25	CE-34	CE-43	
CE-8	CE-17	CE-26	CE-35	CE-44	
CE-9	CE-18	CE-27	CE-36	CE-45	

Note: **Code number identifies location of item in Equipment, Materials and Methods, Literature Available and Films Available Sections, starting on Page 140.**

Name .....
Title .....
Company .....
Address .....
City, Zone and State .....

EQUIPMENT MATERIALS and METHODS

(continued)

Lock Coil Steel Cable

A SINGLE 4-IN. DIA LOCK COIL steel cable, strong enough to support the weight of some 30 medium sized automobiles at once, was drawn more than 2,000 feet across mighty Glen Canyon. The largest and strongest of its kind ever fabricated, according to the manufacturer, the cableway will serve as a "roadway in the sky" to deliver up to 12 yd of concrete at a time to the canyon floor during construction of the Glen Canyon dam and powerhouse.

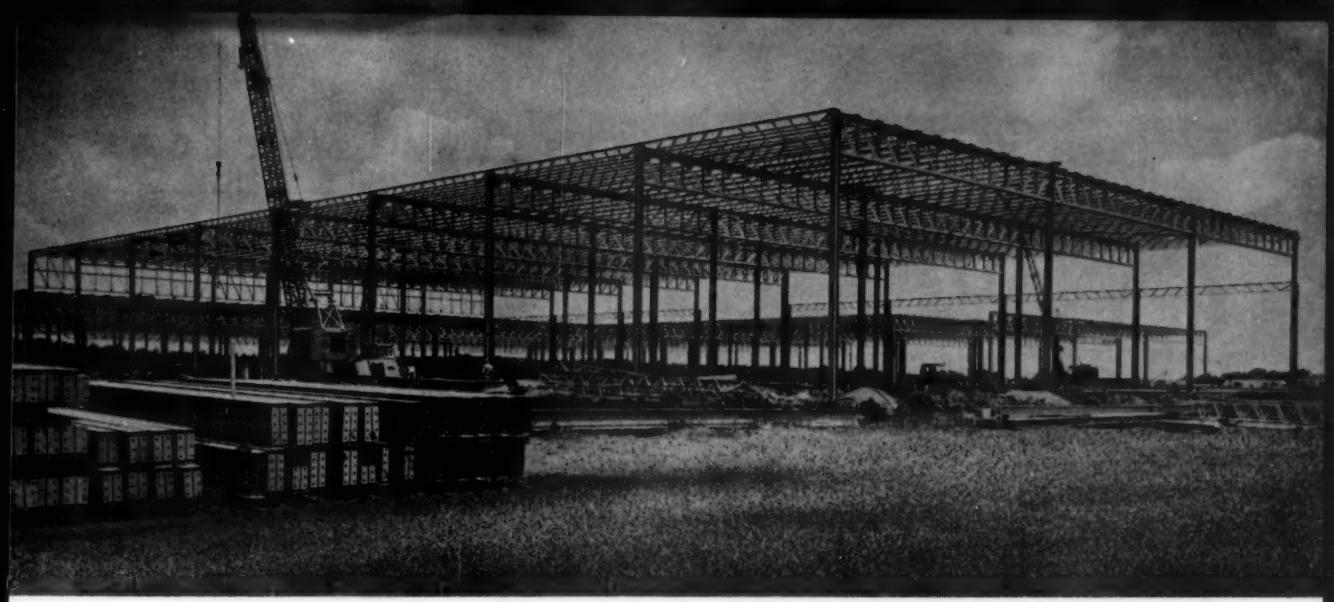
The "main gut" is the first of two 4-in. lock coil cables to be installed by Merritt-Chapman & Scott Corp., prime contractor for the dam and powerhouse on the Colorado River under a $108 million contract awarded by the Bureau of Reclamation. They are specially designed to give a smooth surface over which load-carrying carriage wheels of a mobile hoist will travel. All of the wire in the cables was drawn from selected stocks of steel which were heat treated and cold worked for uniform high strength properties.

The first lock coil cable installed extends between two traveling towers, one of which is 190 ft high, on either side of the 700-ft deep gorge. The A-shaped towers are mounted on 32 wheels which travel on a 910-ft track made of 175-lb rail laid parallel to the canyon edge along the axis of the dam. A second cable will be installed between lower towers also mounted on tracks running directly in front of the highline. They will work independently of each other, with the one extending from the 19-story-high tower, able to pass directly over the lower cable. —CE-5

Structural & Reinforcing Steel

BESIDES FABRICATING THE TOTAL 18,000 tons of structural steel required for the Glen Canyon Dam powerhouse, the company is also manufacturing all reinforcing steel bar; and to facilitate this operation, it has constructed a completely equipped fabricating shop on the east bank of the canyon.

Experience and ingenuity were combined to overcome an early obstacle in the construction of the dam. A 52-deg angle slope in the 40-ft dia spillway tunnel posed a difficult problem for the steel erectors. The company devised an ingenious system by providing a moving scaffolding on tracks which can be rolled down into a tunnel shaft. This device will greatly facilitate the difficult and hazardous tunnel work still facing the construction crews. —CE-6



Meredith Printing Company, Des Moines, Ia.

WHEN IT COMES TO

STRUCTURAL STEEL

YOU'LL DO BETTER WHEN YOU COME TO

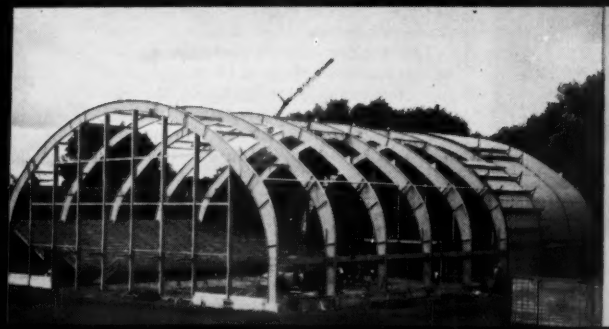
Pittsburgh-Des Moines

Precise shop fabrication and highly-skilled field erection are part of the reasons why. But of equal importance to you are the administrative experience and caliber of supervision that assure smooth operation and on-schedule project completions when PDM handles the job. Six fabricating plants across the country to serve you. Check our nearest office for consultation and quotation, without obligation.

PDM STEEL COMPANY

Memorial Coliseum, Des Moines, Ia.

Auditorium dome, John J. Kane Hospital, Pittsburgh, Pa.



Field House,
Allegheny College,
Meadville, Pa.

Pittsburgh-Des Moines Steel Company

Plants at PITTSBURGH, BALTIMORE, DES MOINES, SANTA CLARA, FRESNO, and STOCKTON, CALIF.

Sales Offices at:

PITTSBURGH (25).....3470 Neville Island
NEW YORK (17)..Suite 2751, 200 E. 42d St.
CHICAGO (3)..674 First National Bank Bldg.
EL MONTE, CAL.....P. O. Box 2012
ATLANTA (5)....361 E. Paces Ferry Rd., N.E.
DES MOINES (8).....971 Tuttle Street
DALLAS (1).....1275 Praetorian Bldg.
SEATTLE (1).....Suite 376, 500 Wall St.
SANTA CLARA, CAL.....677 Alviso Road
DENVER (2)....323 Railway Exchange Bldg.
BALTIMORE (26).....Curtis Bay Station

EQUIPMENT, MATERIALS and METHODS

(continued)

40-Ton CraneMobile

THE 40-TON CAPACITY CRANEMOBILE, MODEL 610-T8440, features removable outrigger beams and supports, durable-duty air brakes on all wheels, power steering, and variable speed transmission with 12 speeds forward and 3 reverse. The front axle clearance is over 13 in.

Strongly reinforced equalizer beams and parallel torque rods equalize weight distribution, insure correct alignment, and withstand all stresses. The complete machine can easily and quickly strip down to 17,270 lb per rear axle and 13,120 lb per front axle. Every inch of the welded alloy steel pin-connected boom is shot-blasted to insure pin-point inspection and prevent rust from abscessing vital parts.

Removable Outrigger Beams

The interchangeable main boom and sections are designed to be equally adept at handling all types of loads from the standard 30-ft boom length up to 150 ft of boom and jib. A two-speed transmission in the crane machinery reduces the raising or lowering speed of loads at the rate of ½-in. per sec.

The CraneMobile can lift and walk with a 63,000-lb load, and can handle 5,000 lb over the rear on 150 ft of boom at 100-ft radius. The large 71-in. O.D. tapered roller path provides smooth swing at 4.63 rpm. The upperworks features as additional standard equipment: foot throttle, precision load-lowering device; positive house lock; swing brake; independent boom hoist; telescopic boom backstops; collapsible Hi-Gantry, and automatic boom hoist clutch safety stop. —CE-7

Lubricants Used on Dam Project

THE COMPANY'S LINE OF LUBRICANTS is playing an important part in much of the equipment now in service on the Glen Canyon Dam project. Some of the construction machinery includes the Limar 2400 power shovel, which works as a drag line in creek bed for gravel for the heavy media plant. The shovel's Caterpillar 397 engine is lubricated with RPM Delco Lubricating Oil.

The GMC diesel engine of the Gardner-Denver 900-ft rotary compressor, which supplies air for rock drills, uses RPM Delco Supercharged #1 Lubricating Oil and the hydraulic medium used is Chevron OC Turbine Oil.

Gravel is brought to the media plant for washing and separation by a Barber Green conveyor from a hopper near the creek's edge. The conveyor rollers are lubricated with Chevron Industrial Grease. —CE-8

Polyethylene Film

A WALL OF POLYETHYLENE FILM—45,000 sq ft of it—was given a major share of the credit for saving hundreds of West Terre Haute, Indiana, homes from destruction when heavy rains turned the banks of the placid Wabash into a churning lake.

When the temporary levee of sandbags and earth erected near the town could not prevent continuous seepage, which threatened to develop into a disastrous break-through at dozens of spots along the dyke, flood fighters appealed for help and immediately received a donation of water-proof polyethylene film.

Heavy gauge film was hurriedly attached to the base of the levee and then draped up the side of the levee that faced the flood and secured at the top with a layer of sandbags, a strategy which effectively alleviated the seepage problem, enabling workers to reinforce the levee against the threat of further flooding. —CE-9

Sealed-System Photocopier

A NEW AUTOMATIC SINGLE-UNIT photocopier, equipped with a sealed processing fluid supply, has been introduced.

Called the Contouramatic Mark 11, the machine provides the advantages of a true photographic process, yet is so designed that the fingers of the operator need never touch fluid. This is the result of the company's "Seal-Pak" system, which employs convenient disposable sealed vinyl bags to contain the processing fluid. This system eliminates handling and mixing, and prevents spilling of processing fluid.

The Contouramatic Mark 11 combines high speed exposure and processing with great versatility in copying ability. It reproduces any mark made by black or colored pencils, regular or ballpoint pens, stencils, rubber stamps, spirit duplicators, chalk, crayons or grease pencils, as well as typing and fine printing. The photocopier makes black and white copies up to 9-in. wide on card stock, colored papers, transparencies, and films for diazo reproduction, blueprints, offset plates, and visual projection. —CE-10

Concrete Release Coating

CONCRELESE IS A NEWLY DEVELOPED coating to prevent the sticking of concrete to all types of forms, and also to act as a preservative coating for the forms. It is the result of a newly discovered formula which approaches the problem from the standpoint of the physical-chemical interaction between the surface of the concrete and the surface of the form.

Easily applied by spraying, brushing, or rolling on the form, it dries quickly and leaves a non-oily, thin coating which absorbs upon the surface of the form and chemically resists the sticking of concrete.

The coating cannot stain the surface of the concrete; there is no migration of oil into the concrete to soften the surface, thus reducing the chance of spalling.

CONCRELESE gives excellent release whether used with ordinary or with Hi-early Portland cement, with high or low slump, and whether cured at ordinary temperatures or with steam. —CE-11

EQUIPMENT MATERIALS and METHODS

(continued)

Epoxy Resin Linings

CONCRETE AND METAL PIPELINES can now be reconditioned in place by lining with acid-resisting epoxy resin. The lining has been developed for pipelines that are subjected to excessive acid attack, such as sewer and industrial waste lines.

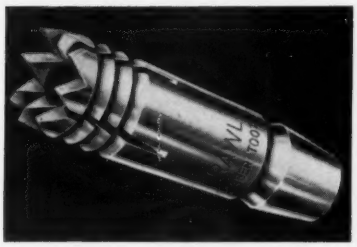
Pre-mixed epoxy resin is applied with special machines that travel through pipes from 24 to 144 in. in dia, and which apply lining material by centrifugal force from a high-speed revolving head, then smoothing it with automatic trowels.

A variety of epoxy resin linings with a minimum thickness of ⅛ in. can be placed in a single pass. The linings consist of pure resins extended and premixed with inert filler materials. **—CE-12**

Masonry Drill-Anchor

FASTENING FIXTURES TO CONCRETE is said to be speeded and simplified by a combination masonry drill-anchor. Called "Saber-Tooth", the new anchor drills its own hole, then is driven into it to form an anchorage with holding power up to 7,860 lb.

Holes are drilled quickly, even in hard concrete, by the drill-anchor's core action.



Matching Sizes No Problem

Since drill and anchor are one, matching sizes is no problem. The drill-anchor saves the cost of special drills and the time it takes to use, store and sharpen them.

The tool may be used with power-operated or hand hammers. When the hole has been drilled, a steel expander plug is placed in the drill end and the anchor driven home. The anchor expands over the plug at the bottom of the hole, for high holding power. **—CE-13**

Hard-Facing Electrode

A HIGH ALLOY HARD-FACING ELECTRODE with high resistance to extreme abrasion, medium impact and high compressive

(Continued on page 146)

(continued)

loads, this material has proven most successful on all types of earth-working equipment such as shovel buckets and teeth, crushers and other parts subjected to the severest types of destructive wear.

A tubular electrode with a dipped graphite coating, it contains approximately 43% alloy materials. Deposits bond readily to carbon, low alloy and manganese steels. They are magnetic, nonmachinable, nonforgeable and will not respond to heat treatment.

Aside from these properties, the new rod has excellent are characteristics on AC and DC, straight or reverse polarity. Weldability and build-up are superior, efficiency is high and spatter loss is low. It may be applied in either stringer beads or wash passes. —CE-14

Tri-Sul-Ite

A SPECIALLY SELECTED GILSONITE that is poured under and around all pipes in the trench, Tri-Sul-Ite forms 3 zones of protection against water, corrosion and heat loss, after proper curing.

The use of this material for underground piping keeps the system free from excessive heat loss and protects it from corrosive soil conditions. It is a low cost, low maintenance, permanent protection system. —CE-15

Front End Loader

A NEW 2-YD, 4-WHEEL DRIVE front end loader has been announced as an addition to the company's line replacing Moto-Loader Model ML-156.

The features incorporated in this new loader are: lift arm geometry that eliminates hazardous "scissors action" inherent in some designs; one-foot control of travel direction and speed for fast, smooth cycles leaves hands free for other operations; excellent work visibility even when all-weather cab is used; all controls located for natural, convenient manipulation; all parts of the machine are easily accessible for inspection and maintenance; and planetary wheel drive, power assist steering, torque converter and fully automatic transmission, and 4-wheel hydraulic power booster brakes are standard.

Operating ranges match today's requirements and the weight distribution and low center of gravity of the loader

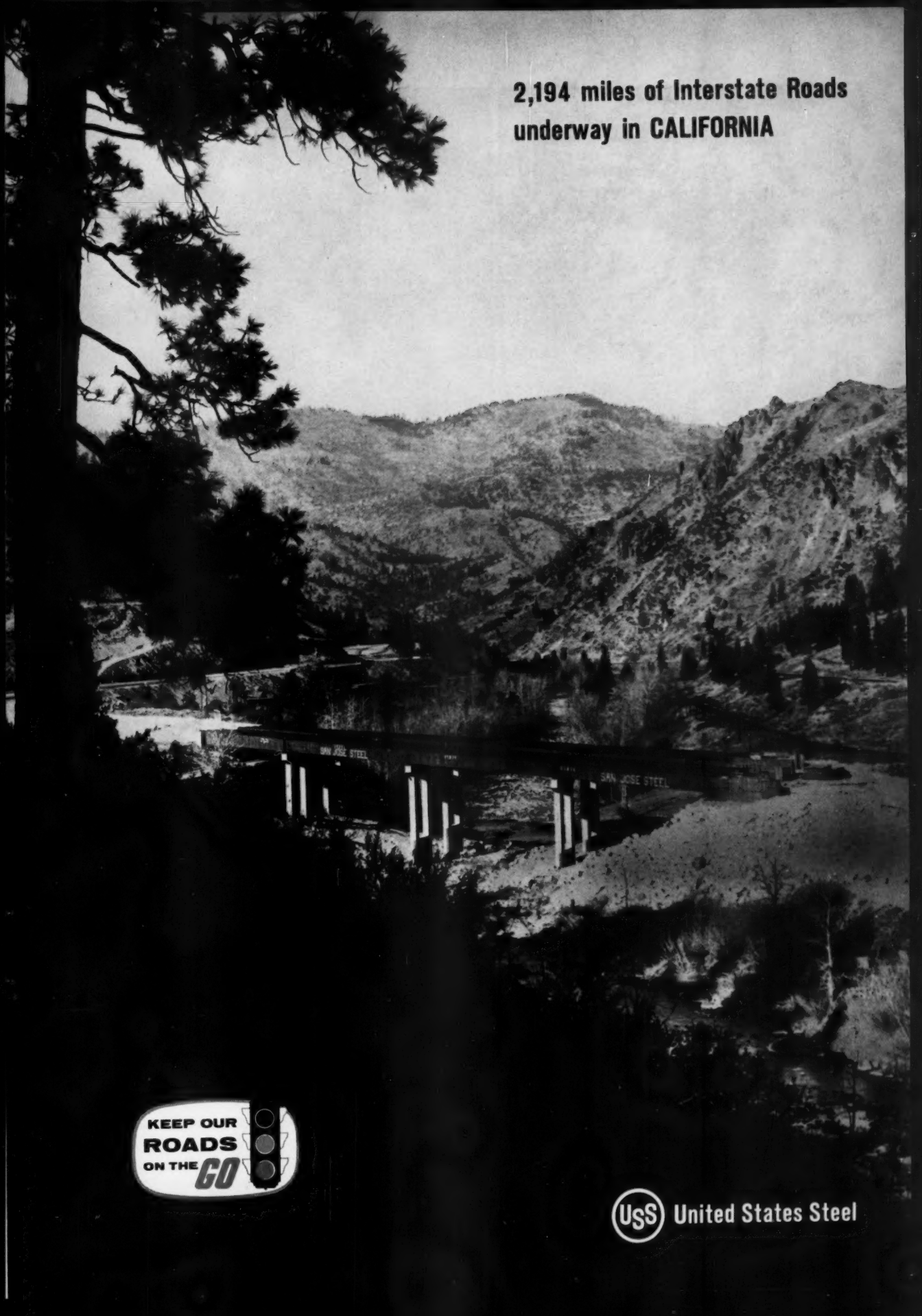
Excellent Work Visibility

give it an unusual balance for maximum stability to dig and carry maximum loads with no bounce, sway or jiggle. With standard gasoline engine weight is distributed 8200 lb on the front axle, 10,900 lb on the rear. Travel speeds are from 3 to 24 mph. —CE-16

Cam-Lok Highway Forms

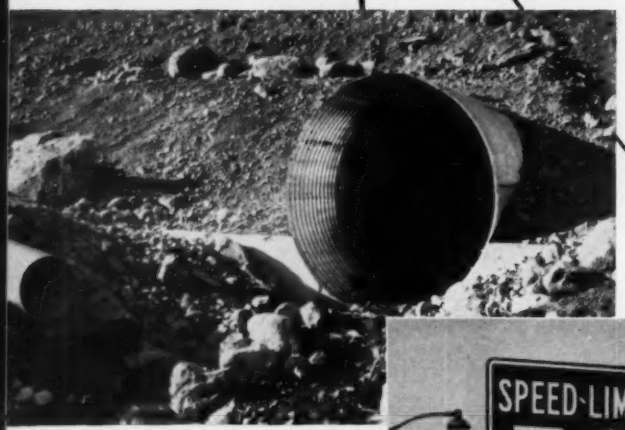
EMBODYING A SUPERIOR NEW CAM locking principle which eliminates sledging and resulting form damage, the Cam-Lok

(Continued on page 150)


2,194 miles of Interstate Roads
underway in CALIFORNIA
SAN JOSE STEEL
SAN JOSE STEEL
KEEP OUR
ROADS
ON THE GO
USS United States Steel

Steel Bridges over the Truckee—Structural Steel bridges carry Interstate Route 80—(U.S. 40) over the Truckee River in the Tahoe area. Over 17,000 tons of structural steel a year help make California's highways among the best in the nation.

California speeds construction



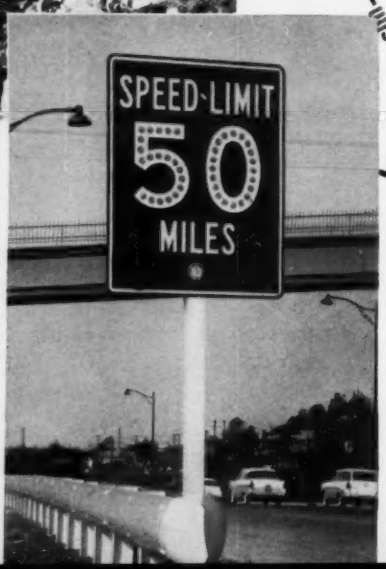
Drainage for Interstate 80—(U.S. 40) USS Galvanized Culvert Sheets and sectional plate structures solve drainage problems under the Interstate Highway at Truckee, California. Here steel provided low-cost, rapid construction.

Completed

Partially completed or under construction.

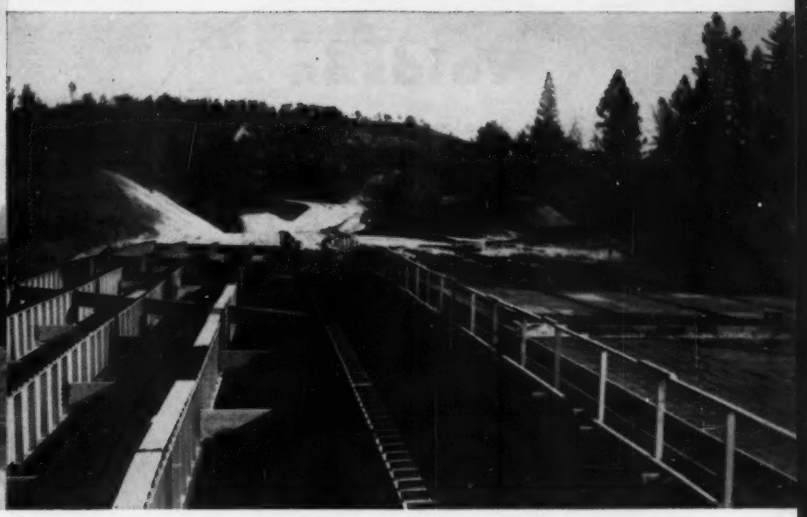
Present highway to be made into Interstate.

These roads are going forward under the direction of: **Robert B. Bradford,** Director of Public Works and Chairman of the California Highway Commission; **G. T. McCoy,** State Highway Engineer.



Steel signs, posts, and guardrail—Available from U. S. Steel are most of the basic products that produce long-lasting, low-maintenance signs and markers; uniformly coated galvanized steel sheets, steel plates and tubular sections for hot-dip galvanized posts, poles, and supports; USS *Vitrenamel* Sheets for porcelain enameled signs. Also shown here is USS *Western* Guardrail on the San Bernardino Freeway, Los Angeles.

Overpass at Albany—Steel girders will be placed on top of these steel-reinforced concrete columns to form an overpass at Albany, California. USS *Di-Lok* Concrete Reinforcing Bars are used for all types of concrete work; and Universal Atlas Cement Division of United States Steel, offers a wide variety of portland cements. *Tiger Brand* Wire Rope is used in cranes, pavers, shovels, ditchers, trenchers, derricks, mixers and road scrapers.



Steel Bridges at Magra—The USS *Di-Lok* Bars in the right-hand side of these bridges at Magra near Gold Run, California, are ready for concrete. The next step in the construction of the left-hand bridge is to place the decking on top of the continuous girder span.

# of 2,194 miles of Interstate Highways

with products from United States Steel

CALIFORNIA'S HIGHWAY COMMISSION has planned 2,194 miles of Interstate Highways to be completed by 1975. 1,453 miles have already been located; 73 miles have been completed, and 170 miles are under construction. Several hundred miles of California's own Freeways are near to meeting the rigid requirements for the Interstate System; when they do, the number of *completed* miles will rise rapidly.

Steel is high on the list of products being used to speed construction on the eighteen highways in California's Interstate System: 3,186 bridges, overpasses, underpasses, and traffic-controlling clover-leafs will be built; 123 bridges are already completed and 194 are now under construction.

United States Steel supplies a complete line of products for highway construction: Structural carbon steel and special high-strength and constructional alloy steels for bridges; steel H-piles, sheet piling and tubular piles for bridge foundations; drainage products; reinforcing bars, welded wire fabric, cements, slag and other pavement construction products; wire rope, cable, tubing and special steels, and steel products for construction equipment; and a complete range of items including fence, beam and cable guardrail, steel for signs, markers, and other accessories. Write for the *free* 54-page booklet, "Keep Our Roads on the Go." This booklet lists all the products and services available from United States Steel to help you cut costs and speed operations in every phase of highway construction. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and trademarks in italics are registered by U. S. Steel

USS **United States Steel**

The highway market is served by the following divisions of United States Steel: American Bridge Division, Pittsburgh, Pa. • American Steel & Wire Division and Cyclone Fence Department, Cleveland, Ohio • Columbia-Geneva Steel Division, San Francisco, Calif. • Consolidated Western Steel Division, Los Angeles, Calif. National Tube Division, Pittsburgh, Pa. • Tennessee Coal & Iron Division, Fairfield, Alabama • Universal Atlas Cement Division, New York • United States Steel Supply Division, Steel Service Centers, Chicago, Illinois.

EQUIPMENT MATERIALS and METHODS

(continued)

Road Form permits faster, easier form setting since a simple quarter turn of the cam draws treads and faces of both form sections into alignment. The resulting joint cannot shake loose regardless of the vertical stress imparted by weight of machines, or the horizontal thrust of spreaders and finishers.

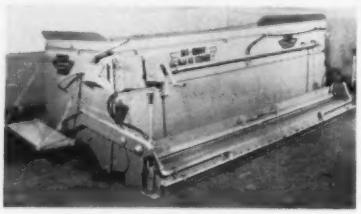
The forms are constructed of ¼-in. Helcoloy steel plate. The rugged channel stake pockets are welded to the form to provide maximum support. The Cam-Lok casing is formed from $^{3}/_{16}$-in. rolled steel plate and rides in a heavy Z-bar slide. A retainer pin prevents accidental loss of lock. The locking cam is a heavy integral casting with a 1-in. square stud, built to withstand years of hard service. Lock guides are provided at each end of the form so that the Cam-Lok may be interchanged. Cam-Loks are easily positioned by hand. A full quarter turn draws the treads and faces of both form sections into perfect alignment. An open end wrench is the only tool needed.

—CE-17

Bituminous Paver

A FAST WORKER ON DRIVEWAYS, parking lots, playgrounds, airports, streets, roads and highways, the bituminous paver is available in 8, 9 and 10 ft widths, with capacities up to 1 cu yd. Its size permits paving anywhere a truck can drive.

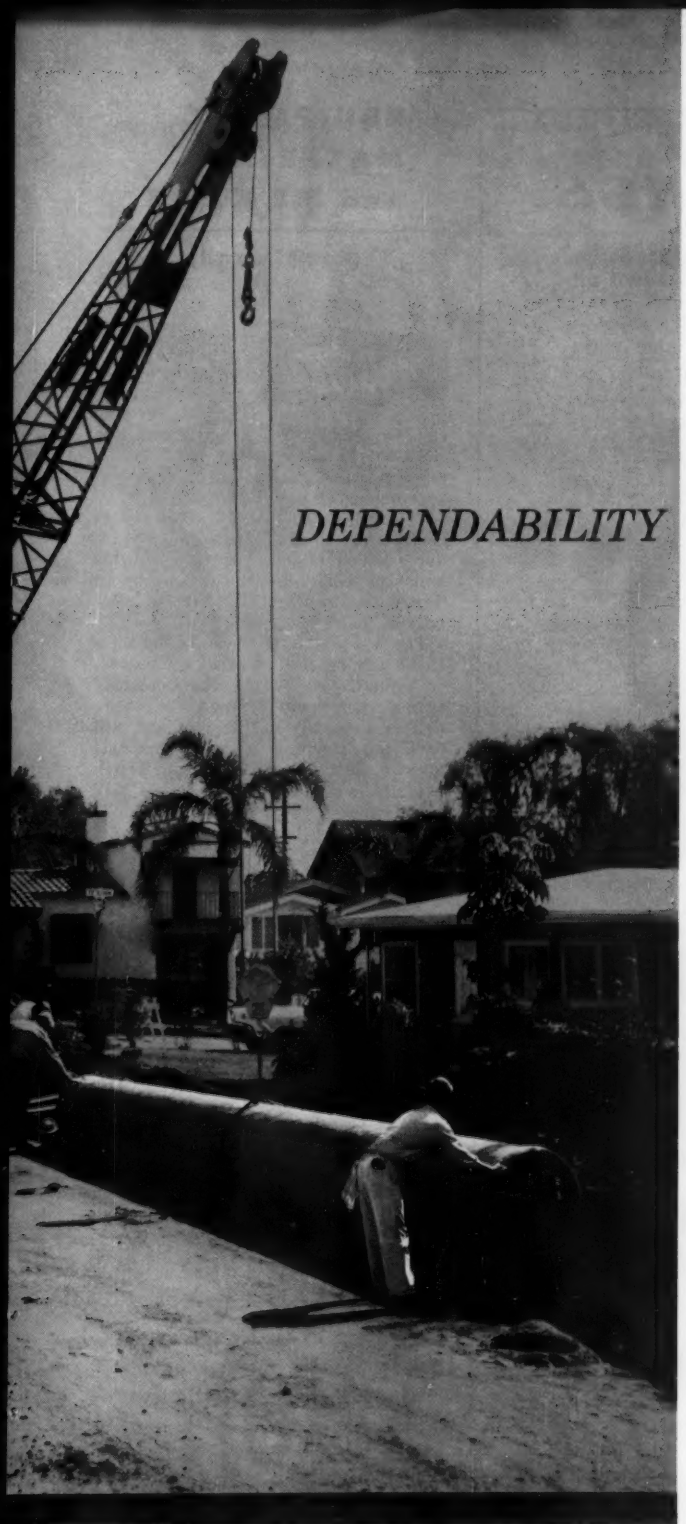
The main labor-saving features are: a completely adjustable, full-floating screed which permits concave or convex surfaces up to 1½-in. crown to eliminate much of the hand labor necessary to prepare a



Model "AS"

bass course. A hydraulic shutoff gate prevents dribbling of material and eliminates emptying paver at the end of a pass.

The versatile paver can be equipped with an optional heated screed to pave both hot and cold mixes. Some contractors even use the Model "AS" to effectively spread aggregates. Specifications include built-in ballast boxes, folding-type operator's platforms on both sides of the paver and a self-coupling hitch for quick hook-ups with any truck. —CE-18



AMERICAN CONCRETE CYLINDER PIPE *provides...*

DEPENDABILITY with ECONOMY

This pretensioned concrete cylinder pipe embodies all of the qualities and characteristics sought by water works engineers for permanent water supply and transmission lines—strength, sustained high carrying capacity; trouble free service and unusually long life. Its competitive initial cost has made it possible for hundreds of water works agencies throughout the West to obtain these desired qualities for pipelines with pressures generally ranging from 100 psi upward, and requiring diameters of 10″ through 60″ (or in many cases larger, where specific project conditions permit). When you select pressure pipe for your permanent water "growth lines," be sure to investigate American Concrete Cylinder Pipe, a superior product with an outstanding record of acceptance.

A. The steel cylinder provides a positive water seal or membrane as well as part of the total steel area required for internal stresses.

B. The smooth centrifugally applied mortar lining of at least ¾″ thickness provides positive internal protection, sustained hydraulic capacity, and, **imparts rigidity and strength through "arching effect."**

C. Steel reinforcement rods, which together with the steel cylinder provide the total cross-sectional steel area required for the operating pressure specified, are wound under controlled tension and accurate spacing around the concrete lined cylinder, placing it under moderate compression.

D. In conjunction with the steel rod reinforcement along the entire surface of the cylinder, the application of a dense concrete coating produces, in effect, a **reinforced jacket** which affords additional structural strength as well as positive exterior protection.

The 32-foot long pipe sections are easily installed with standard equipment using a single cable sling. In addition to providing a watertight seal, the rubber gasketed joint facilitates ease and economy of installation, and eliminates the need for caulking or field welding.

American PIPE AND CONSTRUCTION CO.

LOS ANGELES: 4635 Firestone Blvd., South Gate, Calif.—LOrain 4-2511
HAYWARD: P. O. Box 630—JEfferson 7-2072
SAN DIEGO: P. O. Box 13—CYpress 6-6166
PORTLAND: 518 N. E. Columbia Blvd.—BUtler 5-2531
ALBUQUERQUE: P. O. Box 1782—CHapel 7-0486
PHOENIX: American Concrete Pipe Co. (Subsidiary)
P.O. Box 12127—Alpine 2-7566

CONCRETE PIPE FOR MAIN WATER SUPPLY LINES, STORM AND SANITARY SEWERS, SUBAQUEOUS LINES

EQUIPMENT MATERIALS and METHODS

(continued)

Flashing Light

A NEW 7-IN. TRANSISTORIZED flashing light for large construction and runway jobs has been developed. The large specially designed high impact plastic lens and the longer, slower flash (50 to 60 per min) gives better warning to motorists approaching at higher speeds.

The lens design has an exclusive reflector ring at the outside which produces added brilliance when car lights strike the lens. Incandescent bulbs on all Sentry flashing lights provide a more brilliant penetrating flash.

The self-contained transistorized electronic flashing unit is virtually indestructible and has an unconditional guarantee against component failure. The entire unit is waterproof, vaporproof and will operate continuously off its six volt battery for 2200 hours. The built-in switch is tamperproof. —CE-19

Giant Truck Crane

THREE THINGS WHICH AIDED in the fast erection of high-line towers across the Texas panhandle are: skilled workmen, the simple bolt-together tower design, and mobile long-boomed truck crane.

The simple bolting technique allows each man to work alone and without flailing about; no one tosses anything to anyone. With a pocketful of nuts, bolts and washers, each man can make his connections quickly with a torque wrench.

The tower is put up in sections, each section weighing as much as four tons. A long-boomed truck crane, a Model T-24, raises and holds each section as workmen speedily make the connections. Power up and power down on both the load line and boom make precision spotting easy. The crane has a 100-ft boom with a 20-ft jib, giving it sufficient reach to top out the tower. —CE-20

Boilers Melt Ice

FOUR MOBILE PACKAGE BOILERS will be used in a unique application on the St. Lawrence Seaway. The units will be used to melt the ice accumulated on the lock stop-logs, which are barriers consisting of 10 steel plates 90 ft wide and 8-ft high.

Over each stop-log on the lock side a canvas cover enclosure 90-ft wide, 80-ft high and 10-ft deep will be formed. Into this enclosure on temporary supports will be placed two unit heaters of sufficient capacity to maintain a 70-deg temperature with outside conditions at minus 10 deg.

The boilers, mounted on hard rubber

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EQUIPMENT MATERIALS and METHODS

(continued)

wheels for portability, will be pulled into position and will feed steam at the rate of 1200 lb an hour to the unit heaters and to a steam gun which the operating crew can use to blanket the lock surface. The resulting blanket of steam and warm air will thaw the ice collected on the gate's surface, freeing the gate for action.

—CE-21

Transmission System

PRESENTLY AVAILABLE ONLY IN Diamond T trucks manufactured by the Diamond T Motor Truck Co., the Presto-matic system is a new innovation which completely eliminates the clutch pedal in heavy-duty trucks, with no sacrifice in fuel economy. Instead of a pedal, there is a touch-button control on top of the gearshift lever that engages or disengages the clutch at the slightest touch.

Smooth engagement from a standing start is automatic due to a sensing mechanism which synchronizes clutch engagement with the speed of the engine. The action duplicates the control of an expert driver employing a pedal, effecting full engagement of the clutch as the engine develops its maximum torque.

Similarly, the clutch is automatically disengaged when the engine returns to idling speed. The combination of these two automatic actions permits a driver to inch along in heavy traffic, without ever touching the control or shifting gears.

—CE-22

Streamliner 100

DEVELOPED FOR THE REPRODUCTION of engineering and architectural drawings and a wide variety of business forms, the Streamliner 100 accommodates materials up to 30 in. in width with a synchronized printing and developing speed of 16 ft per min.

The machine has been designed with the operator in mind; all controls are easy to reach, read and work. Positive gravity ammonia feed eliminates the possibility of vapor lock. Other new features include stacking tray for originals up to 12 in. x 30 in. with alternate rear print stacking of 24 in. x 30 in.

The highly efficient cooling system provides a printing cylinder 10 deg to 20 deg cooler than previous models, thus permitting processing of plastic coated materials, foils and photographic film without adherence to the cylinder. Both cylinder and lamp are immediately accessible for servicing and cleaning.

—CE-23

EQUIPMENT MATERIALS and METHODS

(continued)

Portable Spraying Machine

ENGINEERED FOR USE IN CONJUNCTION with a large sprayer, in areas where the large sprayer cannot operate, this new portable spraying machine is ideally suited for use on short runs of pavement, on highway cloverleafs, and for side edge spraying after forms are removed. It has a 15-gal tank.

Minimum Vibration

Two large pneumatic tires make the unit easy to push over any surface and a rear swivel wheel provides easy maneuverability. Vibration is kept to a minimum.

The developed pressure, which is greater than is needed for the spraying action, provides overflow pressure which goes through a "by-pass" system to keep the membrane constantly agitated while the machine is in operation.

—CE-24

Aluminum Transit Mixers

COMING OFF THE PRODUCTION LINE are aluminum transit mixers, which weigh ⅓ less than steel models of the same size.

All parts of the Aluminum Transcretes are made of special abrasion-resistant alloy aluminum except the drive train and mixer controls. The heavy-duty aluminum chutes weigh 60% less than steel chutes, which means quicker, easier handling for the operator.

The mixers have the same basic design features as the company's complete line of steel model Transcretes which are available in Truck Engine Drive and Separate Engine Drive Models in 4, 5, 5½, 6 and 7-yd sizes. These high performance features include Swing-out Hopper, Right Angle Floating Drive, All-Weather Water System, and Progressive Spiral Drum Blading. —CE-25

EQUIPMENT MATERIALS and METHODS

(continued)

Underwater Fastening Device

DEVELOPED ORIGINALLY FOR USE BY the U. S. Navy in underwater salvage work, this tool answers a growing need for quicker and simpler underwater fastening to concrete and steel.

It is expected that the tool will find extensive application in the construction of offshore drilling rigs, hydro-electric dams, underwater dock repair, fixing underwater pipe lines and cables, and perhaps radar and allied military installations.

Designed to function at depths up to 300 ft and for prolonged periods of immersion, the tool can set fasteners instantaneously into $\frac{5}{8}$-in. thick steel plate and high strength concrete. It is also capable of operating at extreme temperature ranges.

The key to the function of the underwater device is a capsule-like barrel which is factory-loaded with a fastener and powder-load and hermetically sealed at both ends. After the tool is fired the entire barrel is discarded and replaced underwater. **—CE-26**

Electronic Conveyor Scale

THIS CONTINUOUSLY TOTALING SCALE easily mounts between strands of any standard flat or troughed belt conveyor from 14 to 27 in. in width. Simple in design yet of rugged construction, it utilizes an electrical transducer to convert instantaneous load weight into proportional voltages for continuous integration and digital display.

Newly designed flexure wishbone assembly restrains the scale idler in horizontal movement permitting only vertical weight displacements to be measured. Static hysteresis record is near perfect and system accuracy is high. Adaptable to existing plant equipment, the scale is efficiently used in simple weighing processes, proportioning, feeding and physical sampling systems. **—CE-27**

Double Right Angle Prism

AN IMPROVED DOUBLE RIGHT ANGLE (hand) Prism with a slotted handle that enables faster target location has been developed.

With the new prism rough sighting of an object can be accomplished even when the object is at a steep angle below the observer. The instrument's larger precision ground optics increase field of view and allow faster sightings.

According to the manufacturer, in addition to street, road and highway sur-

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EQUIPMENT MATERIALS and METHODS

(continued)

veys or plus and offset mapping, the instrument can be used to determine right angles, stake out small areas, line up places for shoring or lay out squares for contouring, making it an efficient aid to engineers, builders, landscape architects, and farmers.

The instrument consists of two ground pentaprisms firmly connected together and completely protected by a two piece metal cover. A simple twist of the cover reveals the prisms for use. The lower part of the hollow steel handle is grooved to accommodate a plumb bob, and can be mounted on a staff if desired.

—CE-28

Solder Joint Valves

DESIGNED FOR MODERN PIPING systems and used with types K.L. and M. copper tubing, Solder Joint Valves feature a distortion-resisting cylindrical-shaped body, and the improved Kenalloy stem for long life and resistance against stem failure. The new valves are suitable for a wide range of services, and are easily installed for a perfect solder joint.

The 427SJ Gate Valve is used for water or steam lines where full flow is required with minimum pressure drop. For heavier than average steam, water, air or gas line operation, the 89SJ Globe Valve is recommended, which features the renewable composition disc and union bonnet. The 440SJ Check Valve is suggested for general service on steam, water, oil or gas line; it can be installed in horizontal and vertical lines. —CE-29

Rain-Tight Wiring Gutters

ACCORDING TO THE MANUFACTURER, these new rain-tight wiring gutters are suitable for all applications requiring positive protection from the elements. Designed primarily for outdoor installations, the gutters feature welded-on tops with deep overhanging flanges to prevent adverse elements from damaging the wiring.

A special sealing device, furnished as standard, helps prevent tampering and the slip-on removable front covers require fewer screws for faster, easier installation and maintenance.

Available in standard 4-in. x 4-in. and 6-in. x 6-in. sizes in 1-ft through 6-ft lengths, the gutters are formed of code gauge galvanized sheet steel, and all are furnished with combination knockouts on the bottoms. Embossed dimples for the mounting screws facilitate installation on any wall surface. Standard finish is a corrosion-resistant gray baked enamel on a galvanized surface. —CE-30

EQUIPMENT MATERIALS and METHODS

(continued)

Machinery Mounting

INCORPORATNG STEEL SPRINGS AS THE vibration-and-shock absorbing medium, a new machinery mounting has been developed particularly for application where noise is as great a problem as vibration. Such problems exist in air conditioning, heating and ventilating.

Designated the Type LR mounting, a unique feature is its all-rubber housing which prevents the transmission of structure-borne high-frequency disturbance and noise. Since rubber has an acoustical impedance 550 times less than that of steel, the material conventionally used in isolator housings, it will stop the noise transmission.

All-Rubber Housing

Primarily intended for use with fans, cooling towers, furnaces, piping, packaged air conditioners, air handling units, turbines, and motor generator sets, the mounting is equally effective in protecting machine tools, instruments, and precision equipment from vibration and shock generated by other apparatus.

Able to carry loads ranging from 150 lb to 1400 lb per isolator, it has a minimum operating height of 4 in. Opposed S-slots in the base of the unit permit it to be removed from an installation simply by rotating the amount 45 deg.

—CE-31

Portable Pipe Welder

A SUCCESSFUL AUTOMATIC CIRCUMFERENtial welding machine for butt welding aluminum pipe has been developed.

There are several sizes of the machine

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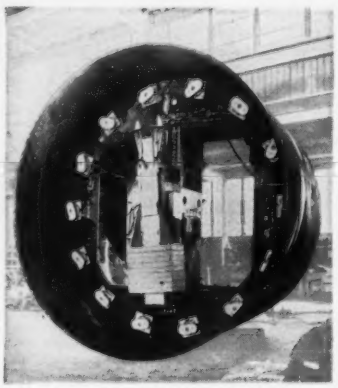

weighing from 40 to 50 lb—so little that they are easily portable. To make a joint, the unit is held in position by a strap clamp and the welding gun and cable drum gear travel around the horizontal axis of the pipe. With this equipment, which has been kept as simple as possible, a 4½-in. dia standard pipe can be butt-welded in less than one minute, without any "programming".

The company states that the unit operates with conventional engine driven DC power sources, is simple in design and requires no specialized service. Welds are of excellent quality. —CE-32

New Dump Trailer

DESIGNATED AS THE A-9000, THIS frameless, single-axle cable dump trailer will sell for considerably less than other type dump trailers of similar 10-12 cu yd capacity and weighs up to 1,000 lb less.

The unit's low price and weight is a result of a unique design concept, which also makes possible sturdier construction, faster dumping, easier loading and a more maintenance-free operation.

The new cable dump gets its lightweight ruggedness from a series of steel U-shaped ribs which girdle the sides and bottom of

A-9000

the load-carrying body shell. Girdles and shell are welded into a strong, rigid, one-piece carrying member. This type of frameless construction puts more steel to work carrying the load while reducing total trailer weight, with the result that the body is rated for a design payload of 40,000 lb. No heavy centerframe is necessary.

Faster dumping with maximum stability is made possible by wide-set lift arms of 6 x 2½-in. rectangular design which tie into the top rail on each side of the trailer. The angle thus created between the lift arms and the cable reduces line pull necessary to start the dump cycle by as much as 22% and eliminates the necessity for a booster fifth wheel.

—CE-33

EQUIPMENT MATERIALS and METHODS

(continued)

Ditcher Spearheads Irrigation Project

CUTTING ITS WAY THROUGH THE black soil of the fertile Rio Grande Valley, a giant ditcher is setting new records in irrigation system construction. This 55-ton ditcher digs trapezoidal irrigation canals in widths up to 22 ft.

The huge ditcher is surprisingly versatile for a machine of its size. It can quickly be converted to a pipeline or deep sewer ditcher, digging straight ditch of mammoth proportions—up to 5½ ft wide and 11 ft deep, This version of the machine, in actual operation, has operated at speeds up to 35 ft per minute. It can quickly be modified at the job-site to cut canals of varying widths and depths. Digging buckets on the main wheel and the rotary side cutters are changed as required by job specifications. The depth of cut is controlled by the digging wheel, which is hydraulically raised and lowered.

Excellent Grade Control

The ditcher can discharge spoil from either side of the machine, or from both sides at once, an important feature, as it allows spoil banks to be built to the required height. These banks will be compacted and later graded to form a maintenance and service road running the entire length of each main irrigation canal.

—CE-34

Dust Control Conditioner

A NEW CONTINUOUS-FLOW dust control conditioning unit has been developed that eliminates the problem of dust during unloading or handling of materials in a wide range of processes. At the same time, the unit called Verticone, suppresses the finer particles in the mixtures and prevents them from segregating at some other point in the process.

The Verticone can be used in a wide

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EQUIPMENT MATERIALS and METHODS

(continued)

variety of applications by engineers and constructors. Normally-dusty construction material, such as rock and stone, are made dust-free in a single treatment. Further, cements and sands are more easily blended into mixes when properly conditioned. Treated gravel, when used for construction roads, is dust-free and tends to allay surface dust, hence visibility is improved in dry weather. The treatment suppresses dust in conveyor systems, crushers, silos, and hoppers as well as in railroad cars and trucks hauling ordinarily-dusty materials. —CE-35

Joist Hanger

A NEW "U" TYPE JOIST hanger for 2-in. x 6-in. to 2-in. x 14-in. wood joists has been developed and introduced to designers, builders and retail dealers.

Manufactured of 16 and 18 gauge, zinc coated, galvanized sheet steel, the joist hanger eliminates ledger stripping, joist notching and bulky strap hangers. It is available in two styles—Type A for joists

Eliminates Ledger Stripping

from 2-in. x 6-in. to 2-in. x 10-in., and Type B for joists from 2-in. x 10-in. to 2-in. x 14-in.

Used for joist to header and beam framing with 2-in. or 4-in. lumber, Teco-U-Grips provide for nailing on both the joist and header. Type A joist hanger measures 5-in. in height, 1⅝-in. in width and has a seat dimension of 2-in.; Type B hanger is 8½-in. high, 1⅝-in. wide, with a 2-in. seat dimension. —CE-36

Literature Available

STEEL PANEL SCAFFOLD SHORING—A new instructional handbook on the use of steel panel scaffolding for shoring has been published. The handbook has sections on applications such as slabs with beams or dropheads, engineering data as well as case histories including actual shoring layouts. Steel panel scaffold shoring is fast replacing traditional shoring materials such as wood and steel posts. Universal scaffolding has such unique advantages as a Gravity Lock, a patented feature that requires no tools for assembling. —CE-37

BLASTCRETE GUNS—A new catalog describing and illustrating the complete line of Blastcrete Guns has been announced. According to the brochure, the Blastcrete Dry Gun method of material placement is superior to the so-called wet gun method. The tensile strength of the end product, with the wet gun method, is greatly reduced because of the excessive amount of water or moisture used. Materials shot dry with the Blastcrete Gun are more than 2½ times as strong as poured concrete, the literature states. Photographs of typical applications and specifications are included. —CE-38

ROLLING DOORS—According to this 36-page booklet, these rolling doors meet nine major requirements: "Registered" life extension; quick, easy operation; space saving; greater durability; fire protection; maximum safety; general protection; neat appearance; and economical installation. Steel rolling service doors, steel rolling fire doors, and bifold doors are a few of the rolling doors discussed in the catalog. Also included are specifications, photographs, and an index to door types. —CE-39

COMPUTER LITERATURE—"Organizational Problems Encountered in Setting Up a Computer" is the title of a 20-page bulletin, which describes solutions to numerous problems that confront an engineering organization in the civil engineering field when contemplating the use of an electronic computer. This paper was originally presented at the Fifth Illinois Structural Engineering Conference, University of Illinois, December 1958, by Elwin H. King of Alfred Benesch & Associates. —CE-40

TRACTORS—A new 16-page booklet covering the 105 series of tractors and tractor units has been published. Included are full color pictures of the 105 Tractor-Dozer, 105 Excavator, Excavator-Dozer Combination, 115 Special Steel Mill Excavator, 125 Front End Loader, as well as specifications on each of these units. Also included are special features of "Unidrive" transmission. —CE-41

Literature Available

POLE BUILDING—A second edition of "How to Design Pole-Type Buildings" has been issued to meet the steadily growing demand and new uses that are being found for low-cost pole structures. Four pages of text, tables and illustrations have been added for those who plan, design, or contract to erect pole-type buildings. Illustrations and text show how to compute live, dead, wind loads, and stresses for every structural member of a proposed pole-type building. The price is $1.50. **—CE-42**

PERFORATED PIPE.—This 28-page catalog deals with perforated pipe for controlling ground water. The subjects covered are single-treatment control; typical methods of solving subsurface drainage problems; cost; selecting the right pipe; recommended methods of installation; and a check list for subdrainage systems. Also included are drawings of standard fittings, tables, and photographs of representative installations. **—CE-43**

ELECTRIC FUELING SYSTEM—This brochure discusses the Davis Remote Control Electric Fueling System, which has sharply reduced the time and cost of fueling such units as tractors, hoe, shovel or dragline units, rollers, graders, snow plows, trenches, dozers, scrapers, and paving machines. By means of the remote control the operator has control of the fuel flow right at the nozzle and can start or stop the flow instantly, thus there is little chance of overflowing the tank being filled. Photographs and specifications are included. **—CE-44**

AIR DIFFUSION EQUIPMENT—A new comprehensive catalog, designed for easy and accurate selection of all types of air diffusion equipment, has been prepared. A special feature of the fully-illustrated 58-page brochure is a color key for identification at-a-glance of the four major product groups in the line. Each section includes detailed selection tables and profuse illustrations of models within the product category. There are also drawings that show graphically how the equipment can be used to best advantage in a variety of applications. **—CE-45**

SPANG HEADERDUCT—Bulletin 490 offers 28 pages of engineering data on Spang Headerduct, covering the components of the system, which are coordinated with cellular floor construction for electrical and communication wiring. Detail drawings with essential dimensions and identifying numbers are given for use on system layouts and specifications. The new bulletin also gives installation instructions for Spang Headerduct and service fittings, and specifications. **—CE-46**

Films Available

"One Hoe for Kalabo"—This 16-mm, 27½-min sound and color film explains what machine tools are and what they do for mankind. The movie contrasts the primitive form of manufacture with today's modern production methods which supply us in quantity with modern comforts and conveniences. Today's civilization, the motion picture states, is made possible only because we have power-driven tools that can cut and shape metal into the working parts of autos, generators, steel-making machinery—in fact every type of mechanism for the home or factory. —CE-47

Fire Barriers—This 16-mm color and sound motion picture shows an actual fire test being conducted on a new field barrier made up of metal and glass doors and frames. The units withstood the test and were awarded an Underwriters' Laboratory "C" label, meaning the frames will withstand fire and smoke for 45 min. The movie tells how they can be placed as smoke and fire screens in the corridors of hospitals, schools, hotels, and other buildings, thus providing an area of refuge within the building. —CE-48

"The New Era of Refuse Collection"—Filmed in full color, this 15-min movie traces the history of refuse collection and points up many present-day problems with animated cartoon sequences and a musical score. Solutions to various problems were filmed on location in well-known plants and cities. Featured in the film is the Dempster-Dumpmaster self-loading packer. —CE-49

"Man and the Moon"—With both Russia and the United States taking dead aim on the moon as reports on recent rocket launchings indicate, this new science film proves to be as current as tomorrow's newspaper. Available in 16 mm to educational film libraries under a long term lease plan, the movie is in Technicolor and has a running time of 20 min. Dr. Wernher von Braun, one of the top men of American rocketry, both assists in the production and appears in the motion picture. —CE-50

"The New D8 Series H"—This fast-paced color motion picture follows the development of the new tractor from the engineers' drawing boards through research testing at proving grounds and on-the-job sites. The viewer is given an inside look at how new models come into being. Important features of the Series H are covered to show how tractor performance and design have been improved. On-the-job sequences indicate that the tractor's features pay off in performance on land-clearing, push-loading and heavy construction jobs. —CE-51

From the MANUFACTURERS

LARGEST BELT SHIPMENT: Nearly six miles of rubber conveyor belting, largest single belt shipment ever made by B. F. Goodrich Industrial Products Co., rolled out of Akron recently destined for use on the world's longest permanent overland transport belt conveyor system. The belting will be installed at the Ideal Cement Co. plant, Ada, Oklahoma, to convey raw material for its recently expanded manufacturing facilities . . . **POWER FOR MOUNTAIN TOWNS:** Four 5000-kw gas-turbine generating units have been shipped from Westinghouse Electric Corporation's steam division in Lester, Pa., to two state-owned municipalities in the remote mountainous part of Sao Paulo, Brazil . . . **SALES OFFICE MOVED:** The Atlanta, Ga., district sales office of The Babcock & Wilcox Company's Tubular Products division has been moved to 464 The Peachtree Bldg., 805 Peachtree St., N. E., Atlanta 8, Ga. . . . **NEW DIVISIONS:** Infilco Inc. announces the formation of a new Petroleum Sales Division. This change is being made to provide more specialized technical service to the industry to aid in the solution of the diverse water and waste treatment problems of petroleum production and refining . . . Superior Stone Co., Raleigh, N. C., a major supplier of basic construction materials in the southeast, has joined the American-Marietta group of companies. Superior Stone operates 20 quarrying and processing plants in North Carolina, South Carolina, Virginia, and Georgia . . . **DEMONSTRATION WAGON:** Another Ridge Tool Co. "Mobile Demonstration Wagon" showing the newest and finest in pipe tools, has been announced. Ronald W. Ifould, a factory trained representative, will be working with Ridgid distributors and their salesmen calling on industrial plants, plumbing, heating, and electrical contractors and hardware stores . . . **DISTRIBUTORS APPOINTED:** Lake Shore, Inc., Service & Supply Div., Iron Mountain, Mich., has been appointed an excavator-crane, Hydrocrane, bucket and parts distributor by Bucyrus-Erie Co., South Milwaukee, Wis. . . . Fincham Equipment Co., Denver, Colo., has been appointed as a distributor for all Kwik-Mix trademark products. Territory assigned to the new sales and service headquarters covers Colorado and the southern half of Wyoming . . . **COMPANY UNDER NEW MANAGEMENT:** The Trailco Mfg. & Sales Co., Hummel's Wharf, Pa., has been purchased from the estate of T. R. Lash by Buch Mfg. Co. Trailco has been manufacturing high quality truck trailers and dump bodies for over 20 years . . . **SELLING ORGANIZATION:** Because of the interest shown in the revolutionary positive displacement rubber-to-metal type Goodyear pump, the newly formed company, Goodyear Pumps Inc., New York City, is setting up a selling organization to cover all parts of the United States . . . **NAME CHANGES:** Aerotech Specialties Inc. has changed its name to United Sensor & Control Corp. The newly named company will remain at the same address: Box 127, Glastonbury, Conn. . . . Vern G. Ellen Co., Inc., Minneapolis, Minn., announces the corporate name of the firm will be changed to Twin City Monorail Co. The company designs, fabricates, and installs overhead-material handling equipment, specializing in monorail systems, crane systems, Vernoflex chain conveyors and trolley chain conveyors . . . **COMPANY SUPPLIES POLYPHENYL ETHER:** Monsanto Chemical Co. has signed a contract with the Materials Laboratory, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, to supply a research quantity of a polyphenyl ether for testing as a high temperature functional fluid . . . **NEW FIRM HANDLES INSULATION SYSTEMS:** Administration and sale of Z-Crete Underground Pipe Insulation Systems have been placed in the hands of Concrete Thermal Casings, Inc. Z-Crete was formerly administered by Zonolite Co., Chicago miners and processors of vermiculite . . . **NEW PLANT:** Announcement has been made by Air Reduction Sales Co., a division of Air Reduction Co., Inc., of the completion of a new oxygen and nitrogen plant at Denver, Colo. . . . **APPOINTMENTS:** C. E. Ponkey has been named president of Layne & Bowler, Inc., Memphis, Tenn., worldwide water well drilling organization.

PROCEEDINGS AVAILABLE

May

Journals: Air Transport, Hydraulics, Pipeline, Professional Practice, Sanitary Engineering Structural.

2014. New Air Terminal For Columbus, Ohio, by G. E. Taylor, Jr. (AT) The new terminal for Columbus, Ohio was dedicated on September 21, 1958. This paper describes some features, and the criteria used in its design.

2015. Special Pavement Requirements for Jet Aircraft Operations by Belmon U. Duvall. (AT) The exhaust heat and blast factors in the ground operations of modern jet aircraft applicable to both commercial and military (U. S. Air Force) categories are described.

2016. Pavement Design for Commercial Jet Aircraft, by F. M. Mellinger, R. G. Ahlvin and P. F. Carlton. (AT) Pavement requirements are given in the form of Design Charts for both rigid and flexible pavements. The design curves cover a range of loadings for the Boeing 707, the Douglas DC-8, and Convair 880 Commercial Jet Aircraft.

2017. Hydrology of Lake Ontario, by F. I. Morton and H. B. Rosenberg. (HY) This paper presents an analysis of the various components making up the water supplies to Lake Ontario. The effects of natural water storage, precipitation, temperature and topography on the components are examined.

2018. Resistance Experiments in a Triangular Channel, by Ralph W. Powell and Chesley J. Posey. (HY) A 400-ft adjustable slope triangular flume was tested smooth and also roughened with small rectangular battens at various spacings. A comparison is made of Mannings's formula with some more recent suggestions.

2019. Model-Prototype Study of a Plumbing Drainage System, by D. A. Gyorog, F. M. Dawson and E. C. Lundquist. (HY) This paper describes how dimensionless groups of variables may be used to express the performance of a plumbing drainage system. Data obtained from tests on a scale model were correlated with those from the prototype in terms of the dimensionless parameters developed.

2020. Resistance Properties of Sediment-Laden Streams, by Vito A. Vanoni and George N. Nomicos. (HY) This paper presents the results of experiments made to determine the relative effects for the flow friction factor of the suspended sediment load and the configurations which form on sand beds of streams.

2021. Gravel Blanket Required To Prevent Wave Erosion, by Enos J. Carlson. (HY) Surface wave erosion tests were performed in a hydraulic wave flume on materials shipped from Yakima Project, Washington. The tests were made to determine the cover blanket needed to prevent leaching of fine base material.

2022. Hydraulic Models of the St. Lawrence Power Project, by J. B. Byrce. (HY) Hydraulic models were used extensively in the design of many hydraulic features of the St. Lawrence Power Project and in the development of a plan for controlling the river during construction. A description is given of the project and the models, and some of the more important findings are discussed.

2023. Engineer-Geologist Team Investigates Subsidence, by M. J. Shelton and L. B. James. (PL) Large areas within the San Joaquin Valley of California are subject to land subsidence which seriously affects the route location and design of aqueducts. This paper describes methods developed to study the nature of subsidence.

2024. Federal-Aid Highways and Public Utilities, by G. M. Williams. (PL) Federal legislation controlling participation with Federal-aid highway funds in costs of adjustments in public utility installations made necessary by highway developments is cited.

2025. Regulation of Pipeline Design and Construction, Progress Report of the Task Committee on Investigation of Problems Involved in Regulation of Pipeline Design and Construction. (PL) Pipeline design and construction is regulated in varying degree by Federal Agencies, State Bodies, and other minor governmental subdivisions. Applicable codes, and administrative orders are presented in this paper. Although presented as a complete compilation, the probable existence of additional pertinent regulations is recognized.

2026. Ethical Aspects of Engineer Recruitment, by William G. Benko. (PP) This paper contrasts present day recruiting practices with the intense aggressive recruiting of a few years ago, illustrates the effect of unethical practices, and acknowledges the graduating engineer's part in these practices.

2027. Humanity Faces A Technological Culture, by Mario G. Salvadori. (PP) An account of the rate of cultural change in the world today and the psychological and human difficulties encountered by mankind as a consequence is given.

2028. The Importance of Balance in Engineering Education, by John B. Wilber. (PP) This paper presents various aspects of educational problems encountered by student engineers. It presents a view opposite to that presented by L. E. Grinter in Proc. Paper 1871 (Dec. 1958).

2029. Problems of County and Municipal Engineers in Civil Service, by Jean L. Vincenz. (PP) The benefits to engineers employed in civil service are reviewed. Continuing salary studies, reasonably frequent classification adjustments, and promotional advantages, together with fringe benefits covering adequate retirement, vacation, and sick leave systems help compensate for the higher salaries in private industry.

2030. Water Quality Problems in the Columbia Basin, by Herbert C. Clare.

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Papers:

Journals (at a cost of $1.50 each):

(SA) This paper reviews maintenance problems of high water quality throughout the Columbia River Basin. As the economy matures, the preventive pollution control program of the area becomes increasingly important.

2031. SED Research Report No. 22: An Evaluation of Two Recent Industrial Waste Processes by the Industrial Wastes Section of SED Research Committee. (SA) This paper is based on the data from two pilot plant studies on industrial waste treatment by recovery methods. The process for the recovery of waste pickle liquor, and atomized suspension technique, for an effective evaporation, drying, and chemical treatment sequence are reviewed.

2032. Radioactive Contaminant Removal from Waste Water: Engineering Design Features, by Mark C. Culbreath. (SA) The first of two papers relating to the design and operation of a plant at Oak Ridge National Laboratory on the collection, treatment, and disposal of large volume (0.5-0.7 mgd), low-level radioactive liquid waste.

2033. Radioactive Contaminant Removal from Waste Water: Evaluation of Performance, by K. F. Cowser and Roy J. Morton. (SA) The second of two papers relating to the design and operation of a plant at Oak Ridge National Laboratory for the collection, treatment and disposal of large volume (0.5-0.7 MVD), low level radioactive liquid waste. The paper covers the performance of the lime-soda softening process treatment plant and shows that it is an effective and economical method for the removal of strontium and other materials.

2034. Effects of Research on Modern American Structural Concrete Design, by Eivind Hognestad. (ST) The organization and the nature of recent structural concrete research in the United States is outlined.

2035. Design Table for Steel Columns With Eccentric Loads, by Richard Hugh Bigelow. (ST) This paper presents a table of bending factors for the design of eccentrically loaded steel columns with an explanation of their derivation. The factors presented differ from those of the A.I.S.C. Manual in that they allow a more precise calculation of the equivalent concentric load.

2036. Load Distribution of Diaphragms in I-Beam Bridges, by Benjamin C. F. Wei. (ST) An analytical study of the effects of diaphragms in I-beam bridges is presented. Several variables are investigated; including (1) relative stiffness of diaphragm, (2) position of diaphragms, (3) relative stiffness of beams, (4) relative dimensions of bridge, and (5) type and position of loading.

2037. Analysis of Two-Column Symmetrical Bents, by B. R. Cooke. (ST) A method utilizing cantilever moment distribution, symmetry, and antisymmetry for the direct solution of many symmetrical two-column structures with loads between joints is presented.

2038. Thermal Electric Pipeline for High-Viscosity Fuel, by A. G. Purdue. (PL) The use of vacuum still bottoms as primary energy source in a thermal generating station is described, with emphasis upon the method of pipeline transportion.

2039. Existing Policies Relative to Pipeline Location Progress Report of the Committee on Pipeline Location of the Pipeline Division. (PL) This report is a summary of answers to a series of eight questionnaires sent to about 100 pipeline companies regarding their pipeline location policies. These queries covered the subjects of road and other crossings, loop line spacing, population density, depth of cover, underground mineral deposits, and swamps.

2040. Discussion of Proceedings Paper 1325, 1480. (AT) S. Russell Stearns closure to 1325. George W. Leslie on 1480.

2041. Discussion of Proceedings Paper 1667. (PL) R. F. Bukacek closure to 1667.

2042. Discussion of Proceedings Paper 1486, 1870, 1871, 1872. (PP) Committee closure to 1486 V. L. Strieter on 1870. V. L. Strieter on 1871. F. C. Lindvall, L. E. Grenler on 1872.

2043. Discussion of Proceedings Paper 1631, 1772, 1816, 1819, 1820, 1821, 1838, 1854, 1867. (ST) Robert A. Williamson of 1631. Alexander Dodge corrections to discussion of 1722. D. C. Gazis closure to 1722. Perng-Fei Gou on 1816 Ming L. Pei 1819. Perng-Fei Gou on 1820. Vitelmo Bertero on 1821. L. Cezek, Milos Volicek on 1838. James S. Hoffman on 1854. R. W. Clough on 1867.

2044. Discussion of Proceedings Paper 1715, 1777, 1780, 1847, 1852. (SA) Harrison A. Martin closure to 1715. Thomas M. Stetson on 1777. Shu-t'ien Li on 1780. M. B. McPherson corrections to discussion of 1780. G. E. Walker, Bernd H. Dieterich on 1847. Philip H. Perkins on 1852.

2045. Discussion of Proceedings Paper 1585, 1662, 1833, 1834. (HY) Max A. Kohler closure to 1585. Tate Dalrymple closure to 1662. I. Alterman, N. Hamlin on 1833. H. C. Riggs on 1834.

2046. Committee on Engineers in Public Practice, by M. J. Shelton. (PP) The Committee, constituted by Board action in October, 1957, participated at its first Convention Session at Los Angeles in February. A resume was given as to the aims and objectives of the Committee followed by a talk on the actions to date and problems.

2047. Problems of Civil Engineers in State Civil Service, Robert D. Gray. (PP) One special problem of engineers' salaries in civil service is the automatic increase. This paper studies the problem and advances a possible solution.

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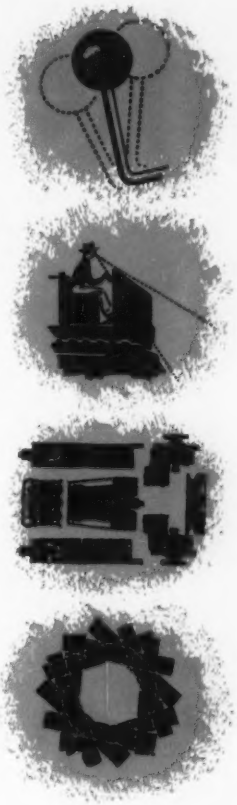

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